AMERICAN GAS JOURNAL

APRIL, 1933 Price 25c

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NEW

Model "F" Combination Thermostat and Oven Valve. Both units—grouped together for convenience and attractive design—are entirely separate in operation and adjustment.

SHOW the Robertshaw . . . and the range is more than half sold.

The records prove it. Over 1,700,000 Robertshaw equipped ranges are now in use. And every one of them is still doing a selling job . . . for the woman who has a Robertshaw is constantly telling her friends about it.

Women today, more than ever before, want the freedom of Robertshaw automatic oven control . . . the relief from kitchen drudgery . . . the certainty of trouble-free performance that is only assured by a *genuine* Robertshaw.

Your best selling plan this year is to push the ranges you have faith in . . . the Robertshaw equipped ranges that you know will give continuous satisfaction and keep free from costly service charges.

ROBERTSHAW THERMOSTAT COMPANY • YOUNGWOOD, PA.

ROBERTSHAW

"AutomatiCook"

33 million advertisements*

TELL THE MAGIC CHEF STORY TO *Buying Women* THIS SPRING

● A strikingly different and compelling series of Magic Chef advertisements are appearing in the leading women's magazines this Spring. To buying women all over the country these advertisements tell the story of the special features that make Magic Chef the most advanced cooking appliance they can buy.

These advertisements also strongly promote the use of gas . . . the most modern cooking fuel.

Counting the combined circulation of the magazines in which this series appears there will be more than 33 million individual Magic Chef advertisements run this Spring to reach potential gas range buyers.

Over a period of 14 years, American Stove Company has used national advertising consistently and regularly to educate women to a higher standard of gas utilization and thereby develop a large and most profitable gas range market for its dealers. During this period considerably more than a billion American Stove Company advertisements have been run in leading national magazines to educate gas range buyers every where to new standards of gas range beauty, efficiency and service.

Now, when as never before, every ounce of effort must be exerted to stimulate gas range buying, and to protect the gas cooking load, this powerful Magic Chef national advertising will prove a substantial help to gas companies and dealers everywhere.

AMERICAN STOVE COMPANY
World's Largest Manufacturer of Gas Ranges
NEW YORK • PHILADELPHIA • ATLANTA • CLEVELAND
CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES

Look for the
RED WHEEL
When you buy a
MAGIC CHEF

Magic Chef
AMERICAN STOVE COMPANY
(Look for this Trade Mark)

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Established 1859

APRIL 1933

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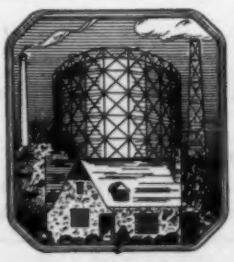


VOLUME 138
NUMBER 4

WHOLE
NUMBER 3712

3

UGI

13.7% Savings in Pipe Line Costs

•

During the past four years we have constructed over a thousand miles of gas mains and pipe lines along highways, through open country, rock cuts and river crossings. This work has been done for twenty-eight different clients for whom we have saved an average of 13.7% of the estimated cost of the work.

•

THE U. G. I. CONTRACTING COMPANY
DIVISION OF
UNITED ENGINEERS & CONSTRUCTORS INC.

New York
1 Wall Street

Philadelphia
1401 Arch Street

Chicago
111 W. Washington St.

MAXIMUM RETURN TO CLIENTS PER DOLLAR EXPENDED

Announcing

NEW *Air-Cooled*

ELECTROLUX

THE *Gas* REFRIGERATOR

IT USES NO WATER

"IT IS NOW CERTAIN THAT A TINY GAS FLAME WILL OPERATE THE REFRIGERATORS OF AMERICA"

An Important Statement concerning the NEW ADVANCE *in* ELECTROLUX

by Herbert H. Springford

President

Electrolux Refrigerator Sales, Inc.

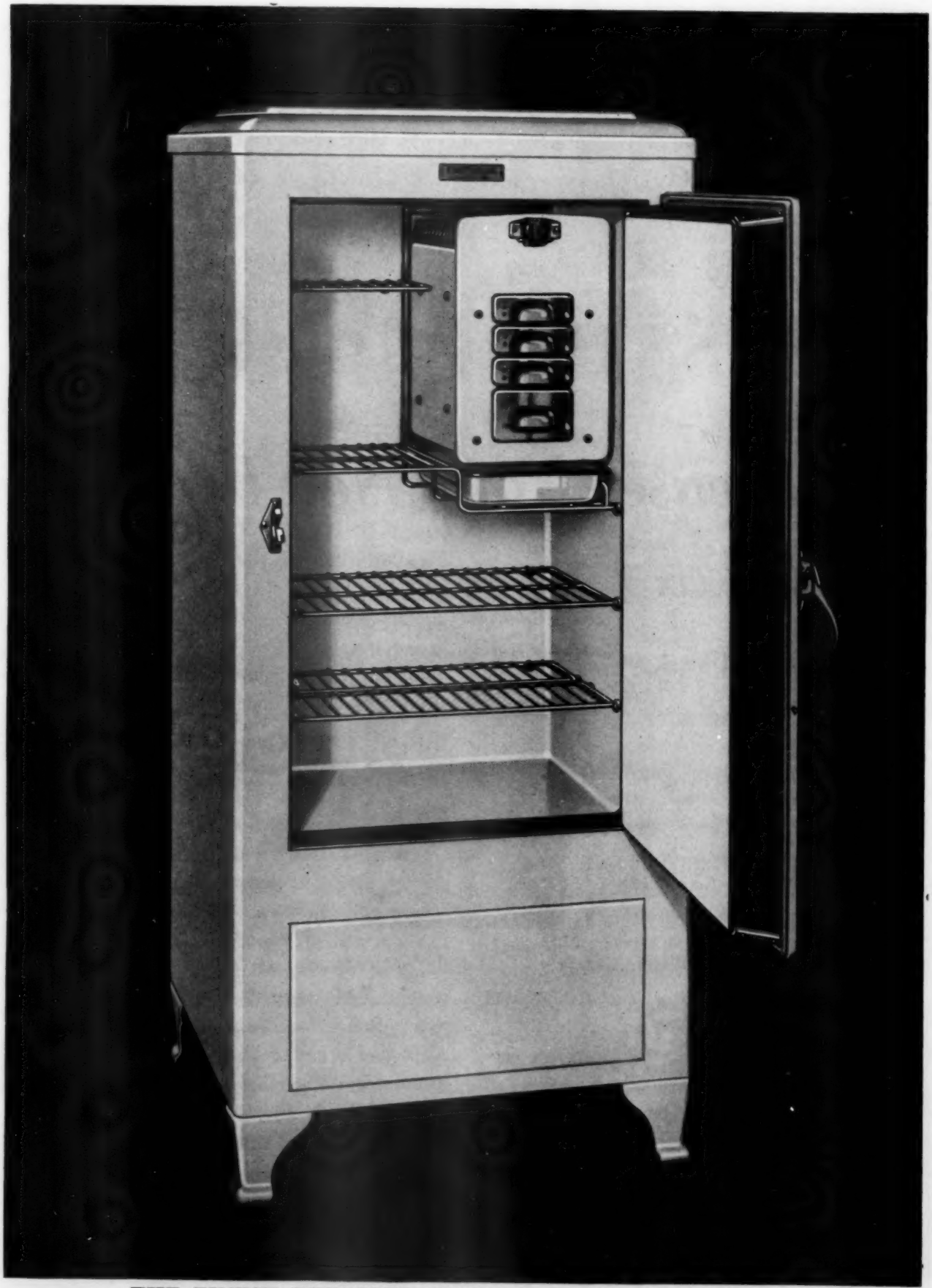
NOT SINCE the introduction of the original Electrolux refrigerator, seven years ago, have we had such a momentous announcement to make to the gas industry. We believe beyond a doubt that the New Air-Cooled Electrolux offers the very finest automatic refrigerator that money can buy today. It represents the furthest advance made by *any* refrigerator manufacturer in the achievement of economical, silent refrigeration. And its widespread use should promote an even greater public acceptance for gas as the modern fuel.

Always confident that the absorption principle of refrigeration was the simplest and most satisfactory known to science, we have in this new advance in Electrolux achieved an even greater simplicity. A simplicity especially valuable to the gas company. The New Air-Cooled Electrolux *uses no water* . . . requires only a single simple connection for gas.

We have been ever grateful for the support which gas companies have given us in the past. Today, more than a quarter of a million Electrolux refrigerators are building good-will and gas-user satisfaction. We say without fear—with perfect confidence in our prediction—that increased effort and support of Electrolux during 1933 will return even greater profits and prestige for individual gas companies and for the gas industry as a whole. We hope you will sincerely share our enthusiasm when we say, "Here is an appliance which the gas companies can be justly *proud* to offer to their customers."

IT USES NO WATER

"IT IS NOW CERTAIN THAT A TINY GAS FLAME WILL OPERATE THE REFRIGERATORS OF AMERICA"



THE FINEST REFRIGERATOR THAT MONEY CAN BUY

How the New Air-Cooled Electrolux

CUTS YOUR SERVICE

Increases Your Net Profits

by F. E. Sellman

Vice-President in Charge of Sales
Electrolux Refrigerator Sales, Inc.

FOUR IMPORTANT THINGS make the New Air-Cooled Electrolux of vital interest in the sales planning of every gas company in 1933.

First: The New Air-Cooled Electrolux reduces your installation costs. There is only one connection necessary—a pipe to the gas line. With flexible copper tubing this is a simple matter. Installation costs with the New Electrolux are 50 per cent less.

Second: The New Air-Cooled Electrolux cuts your service costs. Without doubt, a majority of the service costs on the water-cooled Electrolux were due to unfavorable water conditions. These are now entirely eliminated. Because the New Electrolux is air-cooled, and hence uses no water, your service costs are reduced approximately half.

Third: The New Air-Cooled Electrolux is easier to sell. Not only will the use of water—which in some localities was a disadvantage—be entirely eliminated, but the new simplicity of Electrolux insures owners of even More Economy, More Silence (if anything could be more silent than Silent), More Lasting Satisfaction. All this—plus

IT USES NO WATER

"IT IS NOW CERTAIN THAT A TINY GAS FLAME WILL OPERATE THE REFRIGERATORS OF AMERICA"

COSTS IN HALF . . . .

the many other valuable features (noted in detail in the column to the right)—make the New Electrolux the biggest refrigeration value for any family. Yet prices are lower than ever before!

Fourth: The New Air-Cooled Electrolux means even greater profits from the gas load. With installation costs reduced 50 per cent; with service costs cut in half; with greater consumer acceptance and appeal, which mean more sales, the load from the New Air-Cooled Electrolux will be definitely more profitable. Every Electrolux installed consumes 1500 cu. ft. of manufactured gas every month. It's a 24-hour-a-day, all-year-round load that takes the small convenience user out of the non-profit class.

If you agree that the New Electrolux offers you important sales advantages—if you agree that 1933 is the time you should get behind Electrolux for greater profits and increased load—then don't delay in getting in touch with us at once. And, having taken this important step, make your plans right away to get behind Electrolux during this spring season with special sales effort. We are paving the way for your work with extensive advertising and sales promotion. We'll gladly co-operate to put *your* program into immediate effect. Just write, wire or phone Electrolux Refrigerator Sales, Inc., Evansville, Indiana.

QUICK FACTS *about* ELECTROLUX

1. **Costs less to operate**
2. **Permanently silent**
3. **No moving parts**
4. **Temperature regulator for quick freezing**
5. **Two-temperature evaporator**
6. **Constant, steady cold**
7. **Non-stop defrosting**
8. **Trigger-release trays**
9. **Split shelves**
10. **Uses no water**

Millions of Gas Users the Country

Will Read the Story of

MORE ECONOMY

MORE SILENCE

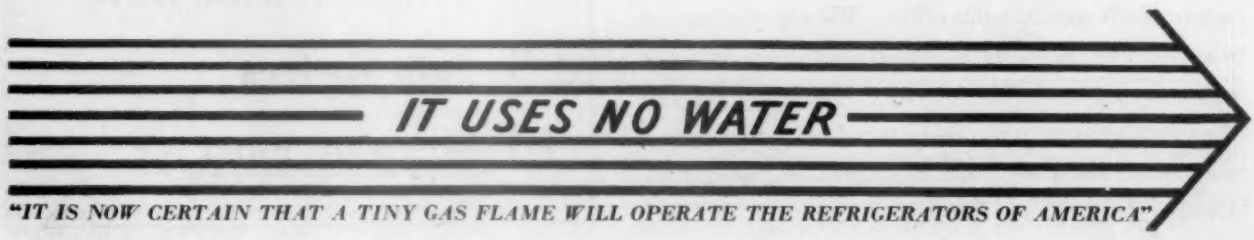
MORE LASTING SATISFACTION

with the New

AIR-COOLED ELECTROLUX

THE NEW Air-Cooled Electrolux is big news! We're going to see that hundreds of thousands, yes, millions of gas users throughout the country—your customers among them—will hear about the New Air-Cooled Electrolux. We're telling them what an amazing refrigerator Electrolux is. We're telling them that they can "Expect More" from this refrigerator . . . more economy . . . more silence . . . more satisfaction . . . and then to even EXPECT MORE. Because the New Air-Cooled Electrolux *will* give them MORE! And that's why these advertisements are going to pave the way for more sales for you . . . more additions to your gas load . . . more profits for you.

Everything is pointing to a banner year for Electrolux sales. All we need is your co-operation in your town. Plan your sales effort now . . . take advantage of the Electrolux co-operative plan for local newspaper advertising . . . send out these convincing mailing pieces. Make 1933 a historic year for the Gas Industry and Gas Refrigeration. Write Electrolux Refrigerator Sales, Inc., Evansville, Ind.



Over, Your Customers Among Them,

THE SATURDAY EVENING POST
Collier's 5¢ a copy
TIME
The Weekly News-Magazine
EXPECT MORE
From a Refrigerator this Year
ELECTROLUX
now AIR-COOLED
Uses No Water
EXPECT MORE
EXPECT MORE
of Electrolux
EXPECT MORE
You will GET it
Announcing the new
AIR-COOLED
ELECTROLUX
at new Low Prices
Uses no Water
DEALER'S
DEALER'S NAME
Arresting Electrolux advertisements appear in the above magazines . . . millions of messages telling gas users the country over to "go to their local gas company showrooms and see the New Air-Cooled Electrolux."
Advance News from your Gas Company
PAID
Colorful, convincing Electrolux literature for you to send to your prospects. No woman or man will put these pieces down without looking at them from beginning to end. The amazing story of the New Air-Cooled Electrolux told in words and pictures.
AIR-COOLED ELECTROLUX is Big News!
TODAY... and YEARS from TODAY you'll
NEW Air-Cooled ELECTROLUX
to SAVE MONEY on Refrigeration

What Prominent Men in the Gas

AIR-COOLED

OSCAR H. FOGG
Consolidated Gas Company, N. Y.

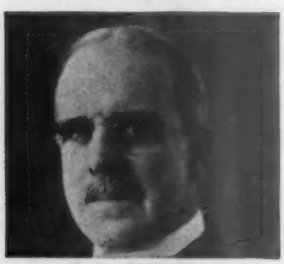
GAS REFRIGERATION HAS ALREADY BEEN A VERY EFFECTIVE LOAD BUILDER AND HAS PROVIDED FOR THE INDUSTRY ANOTHER MEANS OF RENDERING TO OUR CUSTOMERS ECONOMICAL AND EFFICIENT SERVICE STOP THE ELIMINATION OF WATER IN THE NEW AIR COOLED REFRIGERATOR WITH ITS OTHER SIMPLIFICATIONS STRENGTHENS THE INDUSTRY'S ABILITY TO RENDER A FURTHER IMPROVED AND MORE ECONOMICAL SERVICE.

●

CLIFFORD E. PAIGE
Brooklyn Union Gas Company

MESSAGE RECEIVED ALSO JOLT STOP AIR COOLED GAS REFRIGERATOR IS AS MUCH OF AN IMPROVEMENT OVER PRESENT TYPE AS GAS REFRIGERATION IS AHEAD OF ALL OTHER KINDS STOP OPERATION OF OLD TYPE IS WONDERFUL STOP AIR COOLING NOT ONLY IMPROVES OPERATION BUT ELIMINATES THE ONLY DIFFICULT PROBLEM OF INSTALLATION.

●



T. V. PURCELL
Peoples Gas Light Company

CONGRATULATIONS YOUR NEW AIR COOLED ELECTROLUX IS THE MOST OUTSTANDING DEVELOPMENT IN MECHANICAL REFRIGERATION SINCE THE ADVENT OF THE GAS REFRIGERATOR STOP OUR SELLING ORGANIZATION IS TREMENDOUSLY ENTHUSIASTIC ABOUT YOUR NEW PRODUCT AND WE ARE GOING TO REVISE RIGHT AWAY AND UPWARDS OF COURSE OUR REFRIGERATOR SALES ESTIMATES STOP YOUR LATEST CONTRIBUTION TO THE ADVANCEMENT OF THE GAS INDUSTRY IS TIMELY AND OF GREAT VALUE.

●

B. H. GARDNER
Columbia Engineering & Management Company

THE NEW AIR COOLED GAS REFRIGERATOR IS THE MOST STARTLING DEVELOPMENT THE GAS INDUSTRY HAS EVER HAD AND IT WILL PROVE TO BE A GREAT BLESSING TO THE AMERICAN PUBLIC FURNISHING PERFECT CARE FREE REFRIGERATION AT A COST THAT CAN BE PROVIDED FOR IN ANY BUDGET STOP IT IS NOW CERTAIN THAT A TINY GAS FLAME WILL OPERATE THE REFRIGERATORS OF AMERICA.

IT USES NO WATER

"IT IS NOW CERTAIN THAT A TINY GAS FLAME WILL OPERATE THE REFRIGERATORS OF AMERICA"

Industry say about the New · · ·

ELECTROLUX

WALTER C. BECKJORD
Chair'n Commercial Sect., A.G.A.
Boston Consolidated Gas Company

THE NEW AIR COOLED ELECTROLUX REFRIGERATOR IS AN IMPORTANT STEP IN THE MARCH OF PROGRESS OF THE GAS INDUSTRY IN SERVING THE PUBLIC STOP REFRIGERATION HAS RECEIVED BROAD CUSTOMER ACCEPTANCE AND THIS NOW PLACES THE GAS INDUSTRY IN A POSITION TO DOMINATE THE MARKET STOP THE SUPERIOR ECONOMY LACK OF NOISE AND RAPIDITY OF FREEZING ARE ALL MAJOR ARGUMENTS IN ITS FAVOR STOP GAS REFRIGERATION SHOULD BE AGGRESSIVELY PROMOTED BY GAS UTILITIES BECAUSE IT ROUNDS OUT THE COMPLETE GAS KITCHEN AND DEMONSTRATES THE FLEXIBILITY AND CONVENIENCE OF GAS SERVICE.

●

F. M. BANKS
So. California Gas Company

BELIEVE NEW AIR COOLED ELECTROLUX HAS ALMOST UNLIMITED SALES POSSIBILITIES STOP PLANS NOW BEING DRAWN FOR EXPANSION OF OUR SALES ORGANIZATION TO ACQUAINT PUBLIC AS QUICKLY AS POSSIBLE WITH NEW LOW PRICES AND ADVANTAGES OF AIR COOLING STOP OUR 1932 SALES SHOWED SUBSTANTIAL INCREASE OVER 1931 AND WE EXPECT 1933 RESULTS TO FAR SURPASS THOSE OF 1932 STOP IN MY OPINION THE NEW ELECTROLUX IS OF OUTSTANDING BENEFIT TO GAS INDUSTRY AND PUBLIC ALIKE.

●

M. L. SPERRY
Washington Gaslight Company

THE GAS INDUSTRY HAS LOOKED FORWARD TO THE DEVELOPMENT OF THE AIR COOLED REFRIGERATOR AS A MYTHICAL PROMISE STOP ITS MATERIALIZATION MEANS MUCH TO THE ACCEPTABILITY OF GAS AS THE MODERN FUEL WHICH FREEZES BY HEAT.

●

CYRUS BARNES
Chair'n Refrig'tion Comm., A.G.A.
Charles H. Tenney & Company

THE NEW AIR COOLED ELECTROLUX GAS REFRIGERATOR IS VITAL TO THE GAS INDUSTRY IN DEVELOPING SALES OF GAS AND IN HOLDING THE PRESENT DOMESTIC GAS BUSINESS STOP THE GAS REFRIGERATOR MODERNIZES THE KITCHEN AND HOLDS THE GAS BUSINESS FOR WATER HEATING AND COOKING STOP IT IS UNSURPASSED IN THE FIELD OF DOMESTIC REFRIGERATION STOP THERE IS GREATER OPPORTUNITY TO SELL GAS REFRIGERATORS IN THE HOME THAN ANY OTHER APPLIANCES THEREFORE GAS COMPANIES SHOULD PUT THEIR MAJOR SALES EFFORT ON THE GAS REFRIGERATOR.

●

THREE MODELS OF AGP WATER HEATERS . . . .

BACKED BY THREE ESSENTIALS IN SELLING

Quality, Price, Co-operation

Here are three models of quality water heaters at a price range to meet any campaign requirement and backed by sales cooperation to help introduce them.

Each model combines the highest efficiency with improved principles of design and sturdy construction. Perfectly controlled — yet the lowest in price for comparable quality.

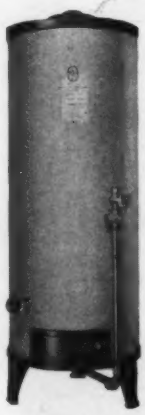
A nation-wide field organization, thoroughly trained and equipped to work with you, will cooperate with any introductory service. All this can be supplied *without* burdening the heater with a price that will make resale difficult.

A. G. P. and Dictator models are made in Everdur Copper Tank as well as in galvanized steel. **For companies needing a water heater of exceptionally long life at a low cost, The Dictator with Everdur Copper Tank can be offered at prices approximating many steel tank prices.**

• Write today! We have a representative near you! •

A. G. P. Gas Fired Automatic Storage Water Heater

Made in galvanized or Everdur tanks. 20-25-30-40-75 gallon sizes.



A. G. P. Special Gas Fired Automatic Storage Water Heater

Made in galvanized tanks. 20-25-30-40-75 gallon sizes.

•

The "Dictator" Low-Priced Water Heater

Made in galvanized or Everdur tanks. —15-20-30-40 gallon sizes.

AMERICAN GAS PRODUCTS CORPORATION

40 WEST 40th STREET, NEW YORK, N. Y.

Division of AMERICAN RADIATOR COMPANY

Editorials

DESPITE the reappearance of the Little German Bands and the well meant "prosits" swapped feelingly over the foaming tankards, the measured thump of the hammer would be just about the merriest music that one could desire. Indeed, this type of harmony has all but disappeared from our midst.

Not only will general business take a decided jump forward but our own gas industry will feel the beneficial effect of widespread home building. When one considers that, of all human activity, more than half eventually finds terminal facilities in the home, we can well visualize the effect on the gas industry.

Any beneficial adjustment of mortgage conditions will immediately give rise to increased home building and then we can talk with more authority about increased appliance sales and we can look forward to a resumption of the industrial load which, after all, helps in turning out materials and tools which are either used in the home, or are necessary to produce other essentials which find tangible lodging in the home.

We have felt for some time that many gas companes could in some way or other tie in the message of home building with their publicity and display. We supply one of the most essential services to the home—flexible, controllable heat—and further as stated, through industry we supply the thermal energy for assisting in producing goods and products which help to make the home. Why not acquaint the public with the beneficial ramifications of gas in this regard?

THE attempts of oil burner salesmen and others connected with that business to place gas for househeating in the same category with oil fuel is sheer tub-thumping. Any one who is familiar with the basic facts of combustion well realizes that nothing burns but gas; consequently, where it is necessary to gasify a fuel and perform a heat transmission operation in one and the same firebox, the overall performance of such a fuel—from both a qualitative and quantitative standpoint—falls short of that attained by a purely gaseous fuel. Further, arguments as to dirt and other derogatory ingredients in city gas is but the attempt of the oil representative to effect a sale in a state of mind that is nothing short of feverish.

Well posted oil heating men know full well that their fuel, in many communities has but one advantage over city gas and that is the matter of cost to the consumer. Further, they also are cognizant of the fact that where the cost of city gas for heating approaches the cost of oil their selling task becomes increasingly difficult. Specifically, when the cost of city gas for house heating runs no higher than ten or fifteen per cent in excess of the cost of oil the oil salesman faces a mighty desperate sales battle. This obviously is based on the fact that qualitatively oil is not in the same class with city gas and the prospective customer does not have to be much of a physicist to be convinced accordingly.

It must be said that the oil burner folks have done a good selling job and they merit considerable credit for the technical development of their unit but, after all, any ability to market their product in a large way is attributable solely to the matter of fuel price advantage—and the better posted oil burner men know it.

ONE of the really fine lessons we are fast learning as a result of the business debacle is that the most important factor in industry is man power. Until the slump set in the furious fulminations of business men and bankers—the latter especially—by and large, placed money at the top, far in advance of the human, as the pass word to success. Obviously, industry cannot function properly without money nor can it carry on successfully without the proper man power—but the latter observation is always the more important factor to be considered.

This painful but purging truth should receive more than passing attention from the gas industry. Specifically, we should recognize the fundamental fact that wealth is measured in terms of productive effort on the part of the great body of physical and mental workers. And prosperity and wealth are better gained when responsibility, based on faith and understanding, is vested in an entirely unhampered manner in the salaried man and laborer alike. Where a relatively large group of gas companies are centered under a single management the officers would do well to appreciate that, within reason, the key men of the individual companies should be allowed to exercise their judgment and abilities without too much red tape, and without too much stint. Satisfactory dividends will amply follow such a procedure.

WITH this issue AMERICAN GAS JOURNAL evinces its faith in the future of the gas industry as well as American business by way of increasing the scope and quality of its editorial service. Had we been faint of heart we might perhaps have waited until general business had definitely started along the upward path before instituting our new program; however, as has always been our policy, we believe that the taking of time by the forelock in anticipation of our readers' needs is not only obligatory on our part but is, in the main, the fundamental reason why we count nearly three-quarters of a century of continuous service to the American gas industry.

Henry M. Riley

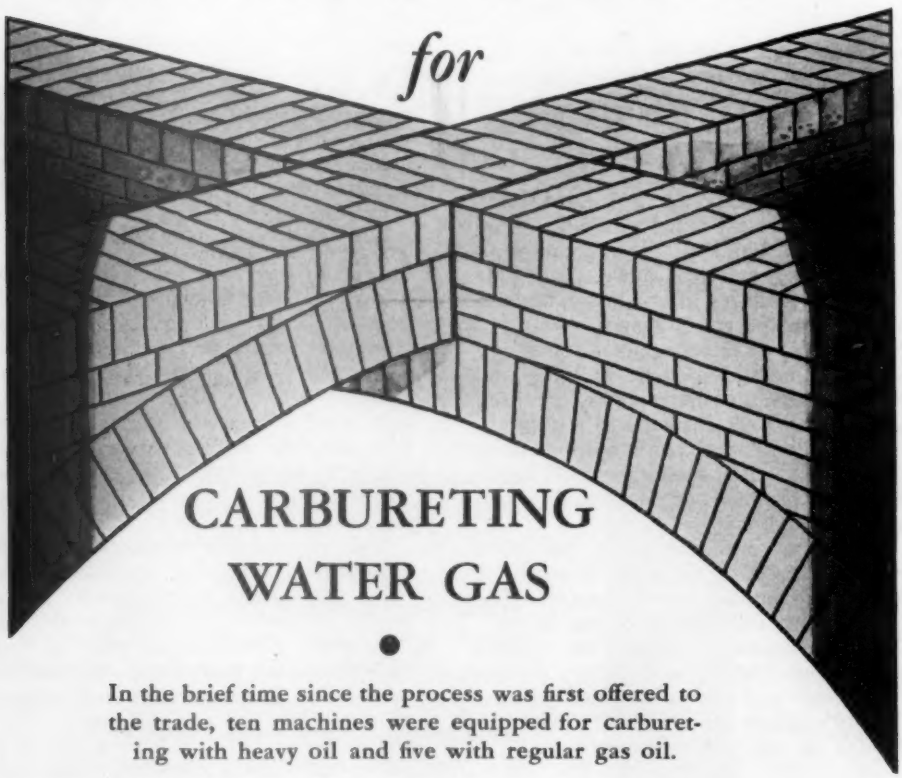
Editor.

The GAS INDUSTRY *has indorsed and is installing the*

SEMET-SOLVAY

IGNITION ARCH PROCESS

for



In the brief time since the process was first offered to the trade, ten machines were equipped for carbureting with heavy oil and five with regular gas oil.

Why? It reduces the holder cost of gas.

It returns its cost in an incredibly short time.

It gets the utmost enrichment out of low cost, heavy oils.

The heavy oil process cuts down the amount of solid fuel per MCF.

It gives more operating flexibility and better heat balance.

It makes load building profitable.

It can be installed at moderate investment cost on any water gas set.

We are prepared to make a calculation, at no obligation whatever, of the advantages to you which the installation of this process offers. We invite your inquiry

SEMET-SOLVAY
ENGINEERING CORPORATION
Engineers · Contractors
40 RECTOR STREET NEW YORK, N. Y.

AMERICAN GAS JOURNAL
April
1933

The Trend of the NATURAL GAS INDUSTRY

By J. F. HANST

IN these days when most industries are in a condition of stagnation and in many cases of despair, the question naturally arises, where is the Natural Gas Industry headed? Will it continue to grow as it has in the past, or is the present development at its peak?

Running a Natural Gas Line through swamp land in Texas

To properly appreciate the magnitude of this question, it will be well, perhaps, to review for a moment the history and growth of this Colossus of industry. Natural gas has been known and used for various purposes for thousands of years. The ancient Chinese used it for evaporating salt brine and for domestic purposes; the Persians and Chaldeans utilized it in their religious rites for centuries before the Christian era; and in France, near Grenoble, there was a "burning fountain" which had been known to exist long before the Roman domination.

Natural gas was first utilized in a practical way on the American continent early in 1821, when the village of Fredonia, New York, drilled a well for the purpose of supplying residents of the town with gas for domestic purposes. Between 1821 and 1860, a few wells were drilled for the specific purpose of finding gas and several localities used it commercially, notably Erie, Fairview and Titusville in Pennsylvania; East Liverpool, Ohio; and Rochester, New York. With the discovery of oil in Pennsylvania, the natural gas industry as such received a tremendous impetus, and from that time to the present, its growth has been continuous.

The last two decades, however, have witnessed an expansion of the industry comparable only to such industrial giants as steel, automobiles and radio. Tremendous new fields have been discovered, enormous reserves have been developed, a network of pipe lines has been built and extended to nearly every section of the country and consumption of this valuable commodity has reached unprecedented heights. The people, to use a modern sales term, have become "gas conscious."

It is a question of interest to all natural gas men, as well as to those identified with manufactured gas, whether the industry has not been over-expanded, and whether it would not be wise to wait until present markets have developed to a point of really profitable operation, before seeking new ones.

The average consumer has only very vague ideas as to the tremendous costs involved in bringing natural gas into his kitchen. He has only a poor conception of heat values, or none at all, and his one idea is that since natural gas is worth only a few cents in the field, it should therefore be supplied to him at a correspondingly low price.

For the consumer's benefit, we will endeavor to point out some of the factors which contribute to the price he is asked to pay. First, there is the matter of drilling gas wells and establishing a satisfactory reserve. The cost of such wells varies from about $3,000.00 to as high as $50,000.00 each, depending on location, depth, and transportation facilities for drilling equipment. The gas company doing the exploration work, particularly in new fields or in semi-proven areas, must count on one hole in three being dry or unprofitable to operate. This naturally increases the unit cost of the profitable wells. Assuming that the company has developed an adequate supply of gas, including reserves, the next thing is the transportation system. This involves gathering lines, main lines, compressor stations, meter stations and all their

APR 17 1933

attendant operating personnel. Investment in a transportation system will generally average $400-$500 per mile per million cubic feet of capacity per day; in other words, a line capable of delivering 60 million cubic feet per day will cost approximately $25,000 per mile exclusive of operating expenses. This cost, however, includes main line, compressor stations, and construction overheads.

Finally, we arrive at the cost of operation and here the important item apart from field charges, is load factor. To earn money, the line must be loaded to at least half of its total potential capacity. Careful calculation of all the items involved shows that it will cost nearly four times as much to operate at 20% load factor than if the load factor were 70%. These costs, using a 16" line as an example, would be approximately 12 cents and 3½ cents per thousand cubic feet per 100 miles of line, respectively, including all operating expense, overheads, and 8% return on the investment.

It is easy to see that there is a definite economic limit to the length of pipe line systems, beyond which they could not operate in competition with manufactured gas, except at very high load factors. For a line 1000 miles in length, if the load factor were maintained at 70%, it would be necessary for the pipe line company to receive 30 to 35 cents per thousand cubic feet at the city gates in order to make a profit of 8%, and on a load factor of 20%. the delivery cost would be $1.00 to $1.20 for the same percentage of profit. To reach the ultimate consumer, the gas must pass through the city distribution system, and its costs added, so that the price paid by the consumer may not, in the end, be very much less than he is accustomed to pay for the manufactured product based on heat value received.

The Immediate Problem

It is the writer's opinion that we have about reached the economic limit for long pipe lines and that for some time to come, more time will be devoted to building up loads and consolidating the markets already open to natural gas. Many long lines built during boom times are not able to operate at a profit today; in fact, most such lines are operating at an actual loss. Practically the only lines which can keep on the right side of the ledger at this time are those within comparatively short distance of their source of supply, who have, in addition, a favorable climatic condition and an established market which guarantees a fairly steady load over at least six months of the year.

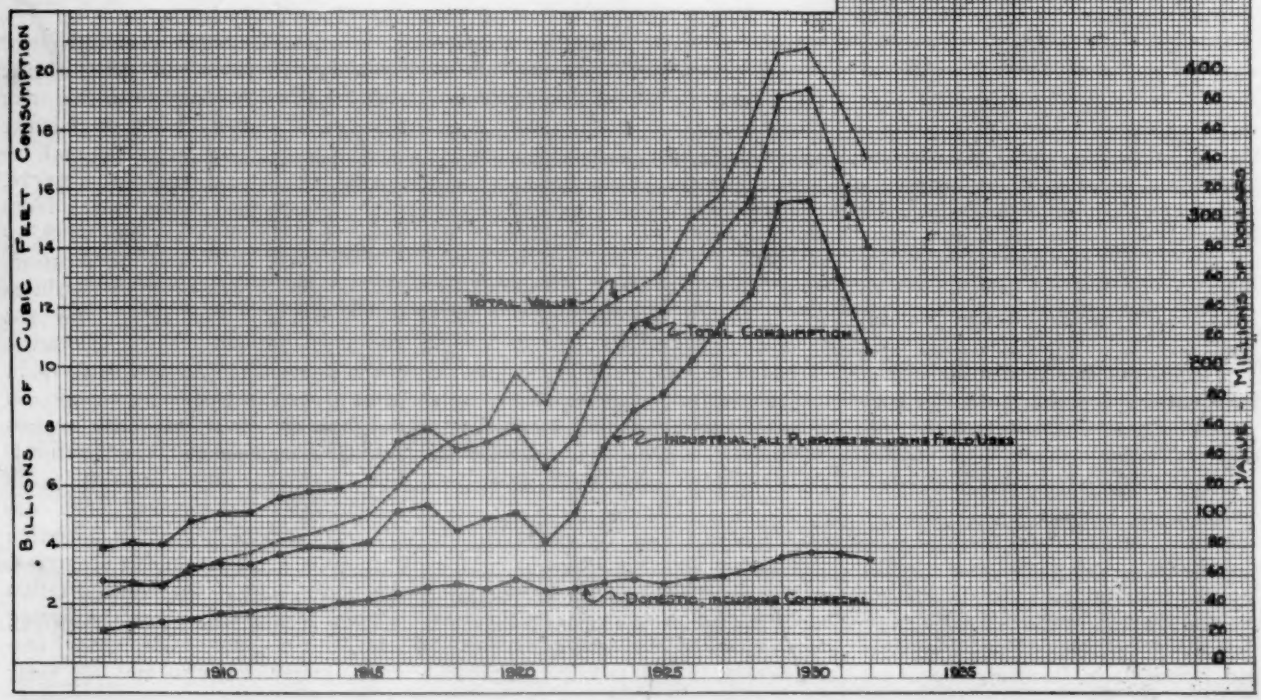
We may therefore anticipate a period of comparative stagnation in the natural gas industry, as far as any further expansion is concerned. Service will probably be extended to certain large industrial centers, where natural gas is already within easy reach. There may even be some new lines built, but such lines will almost certainly be less than 500 miles in length. However, we may expect to see a very intensive selling campaign by the present established companies, with a view of increasing their industrial sales, as it is this branch of the business which must be built up if operations are to show a profit.

Chart 1 gives the picture of what has been happening in the natural gas industry over a period of twenty-six years. It will be noted that the domestic load has shown a steady trend upward and that even during the period of worst depression, the falling off in domestic sales has amounted to comparatively little, only 6.2% in the purely domestic and 2.8% in the commercial sales for 1932 as compared with 1931. On the other hand, the depression years show a tremendous drop in gas sales to industrial users for 1931 and 1932,

(Continued on page 66)

CHART 1

CONSUMPTION AND VALUE OF NATURAL GAS IN THE UNITED STATES 1905–1932



The Effect of ALTITUDE *on the Limits of* SAFE OPERATION *of Gas Appliances*

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Fig. 1. Interior of Altitude Chamber.

I—Introduction

During the several years since the establishment of the Cleveland Testing Laboratory by the American Gas Association, there has been continual cooperation between the Association and the National Bureau of Standards in the matter of fundamental investigations. The results obtained in such investigations have been used to formulate standard methods for testing gas appliances, and minimum requirements which various appliances should meet to insure safety and satisfactory service to the purchaser.

Largely as a matter of chance, the fundamental research which was necessary in order to draft approval requirements and also the routine testing of appliances to determine compliance with these requirements have been carried out at places which are not far above sea level.

The development of better methods of testing, and the realization of the importance to the public of testing appliances have led to the establishment of various independent testing laboratories. Recently, one such laboratory, that of the Public Service Company of Colorado in Denver, found that some of the appliances could be operated with safety in Denver at the gas rates for which they had been approved by the Association's Testing Laboratory in Cleveland.

The Bureau of Standards had available an "altitude chamber" in which a study could be made under substantially normal operating conditions at the barometric pressures corresponding to any desired altitude, and undertook to determine quantitatively the effects of changes in altitude on appliance operation.

Figure 1 shows the interior of the altitude chamber, with a gas range installed for test. The pressure in the chamber could be held constant to 2 mm of mercury or less, this corresponding to less than 100 feet of altitude.

The instruments shown in Figure 1[1] were used to determine the necessary data. The barometric pressure will be expressed throughout the paper in terms of the altitude to which it corresponds.

The following appliances were tested with the mixed gas distributed in Washington: Two "side-arm" water heaters, one of the copper coil type (A), and the other having a cast iron water jacket (B); one gas range with a solid top (C); one single-burner hot plate (D), supplied with an open grid; three space heaters, one of the circulator type (F) and (G); and one gas-fired warm-air furnace (H). All of these appliances had been tested and approved by the testing laboratory of the American Gas Association. To these was added a manually operated gas calorimeter (1). The calorimeter was also tested when operating with propane in order to determine whether the type of gas used affected the results.

The variations in design, character and size of these appliances were considered to be sufficiently great to make the results of the study of this group accurately indicative of what might be expected

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[1] *A Method for Determining the Most Favorable Design of Gas Burners, B.S. Jour. Research, vol. 8, p. 669 (RP 446), 1932, Appendix, describes the instruments for the determination of CO_2 in the flue gases and the proportion of primary air in the mixture being burned. The instrument for the determination of carbon monoxide was a continuous indicator recently developed by the Mine Safety Appliances Co. for the Navy Department.*

from any appliance in common use at this time.

II—Effect of Altitude on the Maximum Safe Gas Rate

The method used for testing each of the appliances listed above was as follows: With the appliance installed in the altitude chamber as it would be in service, and with the door of the chamber open (approximately sea level), the gas rate was adjusted to give the manufacturer's normal input rating measured in B.t.u. per hour. While the gas rate held constant, the proportion of primary air to gas was varied from that which caused yellow tipped flames to that which produced blowing or lifting of the flames. This variation was made in steps, and the proportion of carbon monoxide and carbon dioxide in the flue gases determined at each step. The relative proportions of primary air and gas were also recorded at each setting. By repeating this same procedure at several gas rates and plotting the primary air used against the carbon monoxide produced, it was possible to determine the amount of primary air which was required at each gas rate to give complete combustion.[2]

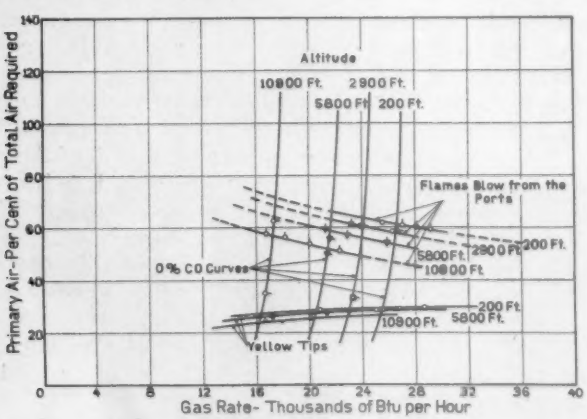


Fig. 2. Effect of altitude on the limits of safe operation of water heater B.

The points so obtained have been plotted in Figure 2. Similar curves (called "0% CO curves") were obtained in the same manner at other altitudes by closing the door of the chamber and exhausting the air until the pressure in the room was the same as the normal barometric pressure at the desired altitude.

Curves representing the relation between the primary air admitted and the gas rate at which the flames blow away from the ports, as well as the amount of primary air which causes yellow tips to disappear from the flame, are also shown in Figure 2.

The flames did not flash back through the ports with any of the appliances tested. There is every reason to believe that they will flash back less readily at a high elevation than at a low one, hence this hazard was not studied.

Figure 2 shows the effect of altitude on the operation of water heater (B), the appliance which was studied in the most detail. The maximum gas rate that can be safely used is shown by the intersection of the "0 per cent CO curve" with the blowing curve obtained at the desired altitude. For example, at an altitude of 200 feet, this intersection occurs at a gas rate of 26,000 B.t.u. per hour, while at an altitude of 10,000 feet, the intersection of the corresponding carbon monoxide and blowing curves occurs at 17,200 B.t.u. per hour.

A comparison of the data obtained with this appliance and intercomparisons between different appliances in many ways at the several altitudes indicated that those based on a constant primary mixture might be most significant. Although data for several primary mixtures were obtained, only those containing 55 per cent of the "total air required" for complete combustion are reported in this paper. This mixture was chosen because it is believed to correspond very nearly to the average adjustment of appliances in service.

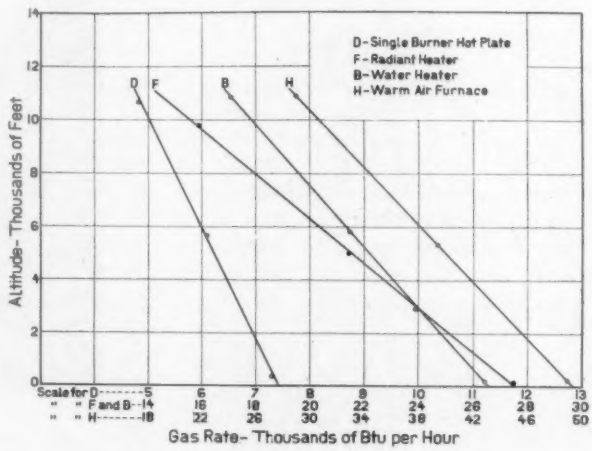

D-Single Burner Hot Plate
F-Radiant Heater
B-Water Heater
H-Warm Air Furnace
Altitude- Thousands of Feet
Scale for D-------5 6 7 8 9 10 11 12 13
" " F and B--14 16 18 20 22 24 26 28 30
" " H-------18 22 26 30 34 38 42 46 50
Gas Rate- Thousands of Btu per Hour

Fig. 3. Straight line relationship between altitude and the rate at which gas can be burned safely.

The maximum gas rate which is safe at any altitude (with 55 per cent of the total air required introduced as primary air) is, of course, given by the intersection of the horizontal line representing 55 per cent air and the "0% CO curve" for that altitude.

These intersections for water heater B are replotted in Figure 3, curve B, which shows that as the altitude is increased the maximum gas rate in B.t.u. per hour must be decreased if complete combustion is to be obtained. Curves D, F and H represent similar data for other appliances. In each case the maximum safe rate in B.t.u. per hour when plotted against altitude yields a straight line within the limits of accuracy of the observations. In view of the varied character of these appliances, it seemed safe to assume that linear relations between maximum safe gas rate and altitude would also hold for other appliances. Thus the necessity of testing at more than two altitudes could be avoided.

In terms of percentage, the maximum safe rate in B.t.u. per hour which can be used at sea level with water heater B (primary air set at 55 per cent of the total required)[3] is reduced 32.4 per cent when the

[2] *For a complete discussion of this method of testing and of representing the results, see Research Paper No. 446, referred to in footnote* 1.

appliance is operated with the same air adjustment at an altitude of 10,000 feet.

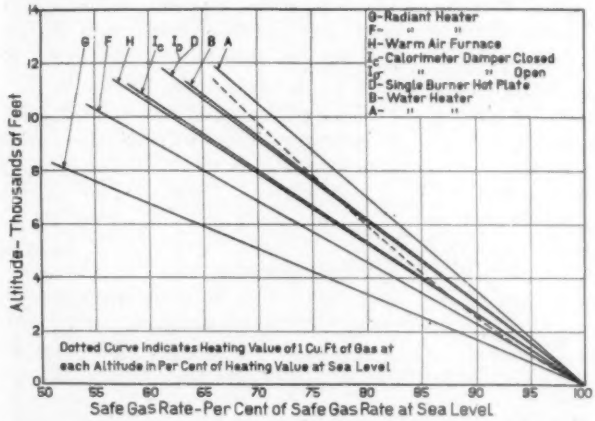

G-Radiant Heater
F- " "
H-Warm Air Furnace
I_c-Calorimeter Damper Closed
I_o " " Open
D-Single Burner Hot Plate
B-Water Heater
A- " "
Dotted Curve Indicates Heating Value of 1 Cu. Ft. of Gas at each Altitude in Per Cent of Heating Value at Sea Level
Altitude-Thousands of Feet
Safe Gas Rate-Per Cent of Safe Gas Rate at Sea Level

Fig. 4. Effect of altitude on the safe gas rate compared on appliances differing greatly in design.

From curves for each appliance similar to those shown in Figure 3, the safe rates in B.t.u. per hour at various altitude have been computed as percentages of the safe rate at sea level and plotted in Figure 4. The safe rate for each individual appliance is represented by a solid line. A reduction of 4.0 per cent of the safe rate (in B.t.u. per hour) at sea level for every thousand feet of altitude appears adequate in practice to protect the user from the hazard of incomplete combustion in all cases except those of the radiant heaters. The peculiar hazard of radiant heaters, together with the fact that the heaters of this type which were tested, showed large and decidedly different reductions in the safe rate with change of altitude, indicates that a very liberal factor of safety should be chosen for these appliances. Certainly, the safe rate at sea level should be reduced at least 6 per cent per thousand feet unless a smaller reduction has been found sufficient by actual trial.

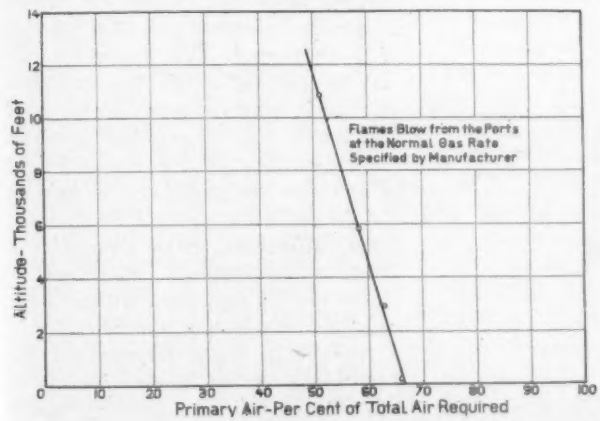

Flames Blow from the Ports at the Normal Gas Rate Specified by Manufacturer
Altitude-Thousands of Feet
Primary Air-Per Cent of Total Air Required

Fig. 5. Effect of altitude on the primary air setting at which the flames blow from the ports. Water heater B operated at the normal gas rate specified by the manufacturer.

[1]*Although the points plotted represent data only for primary mixtures containing 55 per cent of the total air required, corresponding data for other primary mixtures showed substantially the same reduction in the safe rate, when the altitude was increased. The same situation obtains in the case of other appliances, indicating that variations from this primary air setting in practice will not affect the validity of the results obtained on this basis.*

The change which takes place in the heat of combustion of a cubic foot of a given gas with changing altitude is shown by the broken line (Fig. 4). This reduction in B.t.u. per cubic foot is almost the same as the reduction in B.t.u. per hour required in the gas rate for the safe operation of most appliances except radiant heaters. It can, therefore, be readily seen that the average appliance will burn completely almost the same number of cubic feet per hour at one altitude as at another. This unexpectedly simple approximation can probably be used safely as a guide for the adjustment of appliances when they are known to have a fairly large margin of safety at sea level.

III—Effect of Altitude on the "Blow-Off" and "Yellow-Tip" Limits

Referring again to Figure 2, it will be observed that for a constant gas rate both blowing and yellow tips occur at lower primary air settings as the altitude is increased, although the effect on the position of the yellow-tip curve is small. Figure 5, obtained from Figure 2, shows the effect of altitude on the primary air setting at which the flames blew from the ports when water heater B was operated at the normal gas rate specified by the manufacturer. For this appliance the reduction of primary air required to avoid blowing at 10,000 feet amounted to 14 per cent of the total air required. When we consider that the range of safe adjustment lies between the blowing and yellow-tip curves and to the left of the "0% CO curve," (Figure 2) it is evident that the range of safe adjustment is greatly reduced at an altitude of 10,000 feet.

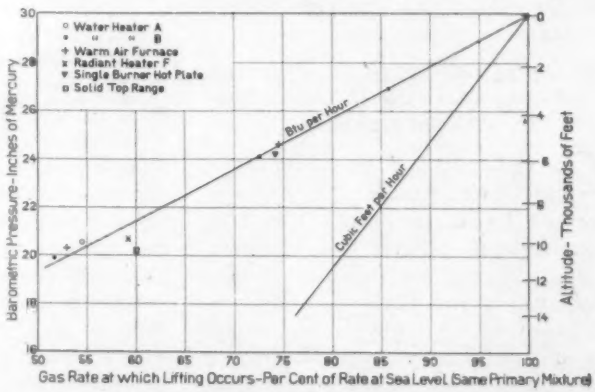

Water Heater A
" " B
Warm Air Furnace
Radiant Heater F
Single Burner Hot Plate
Solid Top Range
Btu per Hour
Cubic Feet per Hour
Barometric Pressure-Inches of Mercury
Altitude-Thousands of Feet
Gas Rate at which Lifting Occurs-Per Cent of Rate at Sea Level (Same Primary Mixture)

Fig. 6. Effect of altitude on the gas rate at which lifting occurs with any given primary air setting. An average of five appliances.

If, instead of comparing the amounts of air which cause lifting of the flames when gas is supplied at the same rate (in B.t.u. per hour) at various altitudes, the rates of flow of the same primary mixture are compared, a simple relation appears. It is found that lifting occurs with any given primary mixture at an altitude of 10,000 feet at about 56 per cent of the rate in B.t.u. per hour at which lifting occurs at sea

level, and that if the ratio of the rate at each altitude to the rate at sea level is plotted against barometric pressure, a straight line results. Average data obtained from several appliances are plotted in Figure 6. This figure also shows that the volume of the primary mixture passing through the port when lifting occurs at 10,000 feet is about 82 per cent of that passing at sea level. The data obtained with several appliances at several air-gas ratios agree within the probable limits of error of observation.

From this figure and a lifting curve obtained at one altitude, it should be possible to construct with fair accuracy the lifting curve for any other altitude, by making the indicated changes in the rate at which lifting occurs, for each of several primary mixtures.

IV—Effect of Altitude on the Area of Flue Opening Required for a Given Gas Rate

A reduction of the barometric pressure (increasing the altitude) causes the volume occupied by 1 cu. ft. of gas at sea level to be increased. Similarly, the air required to burn this gas would have its volume increased in the same ratio, and so would the total volume of products of combustion and excess air which must escape through the flue opening.

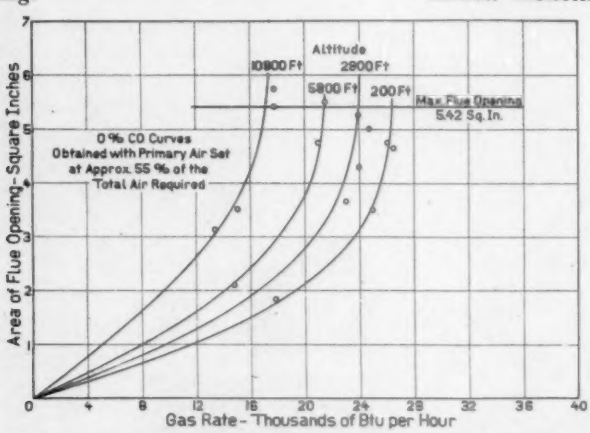


Fig. 7. Effect of reducing the area of the flue opening of water heater B on the safe gas rate for various altitudes.

The supply of secondary air to the appliance and the escape of products of combustion from it depend on convection through its open passages and, therefore, on the resistance to flow through such passages. The air inlets, combustion space and flue passages should be considered as a whole; but in many appliances the resistance to flow is mainly determined by the minimum cross section of the passages, and frequently this occurs at the outlet or "flue collar". The expenditure of the time required for a thorough study did not appear to be justified, but observations were made of the effects which could be simply produced by changing the size of the flue outlet.

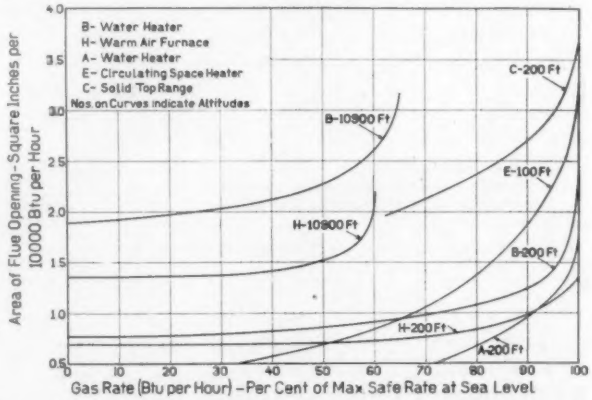

B- Water Heater
H- Warm Air Furnace
A- Water Heater
E- Circulating Space Heater
C- Solid Top Range
Nos. on Curves indicate Altitudes
C-200 Ft
B-10900 Ft
E-100 Ft
H-10900 Ft
B-200 Ft
H-200 Ft
A-200 Ft
Area of Flue Opening - Square Inches per 10000 Btu per Hour
Gas Rate (Btu per Hour) - Per Cent of Max. Safe Rate at Sea Level

Fig. 8. A comparison of the areas of flue opening required per 10,000 B.t.u. per hour for several appliances of different design.

In a typical experiment, the primary air was set at 55 per cent of the total air required, with the appliance operating near, and sometimes slightly in excess of, the maximum safe gas rate. The area of the flue opening was then decreased by steps, and the carbon monoxide, carbon dioxide and the temperature in the flue gas determined at each step. This process was repeated at each of several lower gas rates and at each of several altitudes. By plotting the area of the flue opening against the carbon monoxide produced, it was possible to determine the area of the opening at which combustion became incomplete.

Figure 7 shows a curve obtained in this manner for each of four altitudes, from which the area of flue opening required for complete combustion at various gas rates can be obtained for water heater B. For example, at a gas rate of 16,000 B.t.u. per hour the smallest area of flue opening which will permit complete combustion at an altitude of 200 feet is 1.5 sq. in. In order to burn gas at this same rate at an altitude of 10,900 feet an area of 4.25 sq. in. is required.

Since each of the curves in Figure 7 is approximately vertical at the maximum flue opening of 5.42 sq. in. it is evident that at no altitude would the safe capacity of this appliance be materially increased by enlarging the flue opening, the capacity being limited by factors other than the area of the flue outlet.

Other appliances differ radically from this one. The resistance to flow through the construction at the flue collar may constitute almost the whole of the total resistance to flow through the appliance, or only a minor fraction of it. Incomplete combustion may result from the impingement of the flame on relatively cold surfaces under conditions which are nearly independent of the amount of excess air. The secondary air may be directed within the appliance so that it may or may not be used effectively for supporting combustion. Great differences in the height of the flue outlet above the burner, and in the temperatures of the flue gases, affect the head available to produce circulation. Leakage of flue gases through loose fitting doors or other openings is also a factor.

It is convenient to express the data in terms of square inches of flue area required for each 10,000 B.t.u. per hour, and the gas rate at which combustion becomes incomplete, as a percentage of the maximum safe rate, in B.t.u. per hour, at sea level. Curves plotted on this basis are shown in Figure 8.

It is again evident that the safe gas rate at high altitudes cannot be materially increased for either appliance B or H merely by enlarging

the flue outlet; otner parts of the appliance would have to be redesigned as well. At sea level it is obvious that in no case, except possibly the warm-air furnace H, would further enlargement of the flue passages greatly increase the amount of gas that could be burned, unless other changes were made also. It is believed that the relatively large amount of gas that could be burned completely with very small flue outlets in appliances A and E was the result of leakage of flue gases through other openings.

For preliminary estimates by the designer of a water heater or other appliance in which the secondary air is effectively utilized by a free-burning flame and a good head exists to produce circulation, it appears that two square inches of flue-way per ten thousand B.t.u. per hour of maximum demand at sea level should be a satisfactory figure. This does not mean that an appliance having this area of flue-way will necessarily be free from the hazard of incomplete combustion; still less does it mean that it will be safe to obstruct the larger flue of an appliance already built. What it does mean is that, if a designer uses a flue of the size computed from this factor and finds that the appliance does not burn the desired amount of gas completely at sea level, any considerable improvement is to be sought from changes in other details of construction rather than from an increase in the size of the flue outlet.

To construct an appliance for use at a high altitude, it must be designed as a whole to burn at sea level an appropriately greater quantity of gas.

The temperature of the flue gases was found to have very little relation to the altitude. It appeared to be almost entirely a function of the gas rate in B.t.u. per hour.

V—The Effect of Altitude on the Total Volume of Flue Gases

In Figure 9, curves are presented (from water heater B) showing the variation of the proportion of carbon dioxide in the flue gases with the gas rate, for each of four different altitudes, the primary air being held at 55 per cent of the total air required.

As can be seen from this figure, a given concentration of carbon dioxide is obtained at a lower gas rate when operating at a higher altitude.

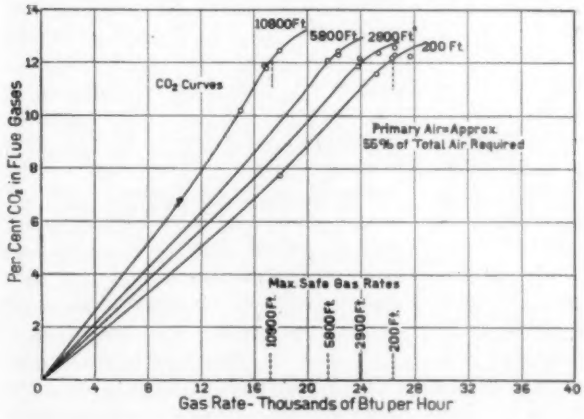


Fig. 9. Relationship between the gas rate and the CO_2 content of the flue gases from water heater B at various altitudes.

The broken lines in Figure 9 indicate the gas rates above which carbon monoxide appeared in the products, for each of the four altitudes. When operating at an altitude of 200 feet, this gas rate is 26,400 B.t.u. per hour. Referring to the carbon dioxide curve for 200 feet, it is seen that at this gas rate the concentration of carbon dioxide was 12.1 per cent. The same situation obtains at the other altitudes.

Evidently, a carbon dioxide concentration of 12.1 per cent is the highest obtainable with this appliance without incomplete combustion, irrespective of the altitude at which the appliance operates. This corresponds to excess air to the extent of 15.0 per cent of the total air required, which is unusually low.

Similar curves for other appliances indicate that when combustion became incomplete the excess air had been reduced to definite although somewhat higher values. Table 1 shows the excess air present when combustion became incomplete in the cases of the four appliances tested which were capable of yielding this information.

Table I

Carbon Dioxide and Excess Air at the Maximum Safe Gas Rate

Appliance	CO_2 %	Excess air at maximum safe gas rate; average for various altitudes. Percentage of total air required
Water heater B	12.1	15
Warm air furnace H	10.5	31
Water heater A	9.8	40
Circulator E	8.6	59

It was pointed out in section II that the maximum safe gas rate in cubic feet per hour (not B.t.u. per hour) is nearly independent of altitude. Since the volume of the products of combustion bears a constant ratio to the volume of gas burned and can be computed from analysis (1 cu. ft. of the mixed gas used in the investigation produced 5.12 cu. ft. of products), the volume of products at the maximum safe gas rate is also nearly independent of altitude. It has just been shown that the percentage of excess air in the flue gases at the limit of complete combustion is independent of altitude within the limit of observation, and all these facts taken together lead to the following roughly approximate relation. If an appliance is moved from one elevation to another, the maximum safe gas rate in cubic feet per hour (measured at local barometric pressures) and the corresponding volumes of primary air, secondary air, products of combustion and flue gases will remain approximately unchanged. The rule is to be used only as an approximation. There are important departures from it which have been discussed in section II.

A mental picture of what happens in the typical appliance may be had by considering the products of combustion as occupying an increasing proportion of the total capacity of the flue passages as the gas rate is increased, while the amount of secondary air which enters the appliance does not increase in proportion, and finally becomes insufficient to complete the combustion of the gas.

The constant excess of secondary air present in the flue gases in a given appliance when this condition is reached may be regarded as indicating the effectiveness of application of the secondary air.

(Continued on page 62)

Notes on High Pressure Gas Distribution

Governor Complaints and How to Correct Them, also Proper Procedure in Installing Governors, Discussed by DISTRIBUTION ENGINEER

A GOVERNOR or regulator involves several principles of physics during operation. With the valve in an open position, expansion occurs when gas passes through the orifice due to the lower pressure on the outlet side. This expanding gas fills the gas chamber beneath the diaphragm and the outlet. If the outlet is closed, the continued flow of gas into the gas chamber gradually increases the pressure in this chamber which raises the diaphragm. As the diaphragm rises, its motion is transmitted through a hinge into the lever arm which moves upward at the diaphragm end causing the valve to move toward the orifice, decreasing the volume of the opening between orifice and valve disc thereby lessening the flow of gas; but the gas still entering the gas chamber at a gradually diminishing rate, continues to raise the pressure and move the diaphragm upward. This action continues until all forces are balanced, this condition occurring when the pressure in the gas chamber raises the diaphragm sufficiently to close and seal the valve. Gas consumption on the outlet of the governor lowers the pressure in the gas chamber causing the diaphragm to drop and the valve to open correspondingly. The valve travel, which is the distance a disc moves from the orifice, is proportional to the consumption of gas up to the capacity of the governor.

The pressure at which all forces are balanced with the valve completely closed and the pressure in the gas chamber remaining constant, is termed the lock-up pressure.

Governor Complaints—Practically all improper functioning of a governor has an external cause, the most common being foreign material, generally in the form of solid particles of iron, iron-oxides, dirt, carbon and matter from purifiers, and to a less extent, water, drip oil and gums. Internal causes of improper functioning are due mainly to faulty construction material rather than faults inherent in the design of modern house governors.

An analysis of the causes of governor complaints on 2820 calls by consumers showed that 83.2% of the total were governors blowing due to foreign matter other than tar or gums on the discs. The remaining 16.8% were caused by the governor sticking from tar or gum, resulting in no gas; leaks around the governor flanges or fittings adjacent to the governor; a few from vibrating governors and none due to lack of governor capacity. In several of the above cases the consumer did not report governor trouble but called for service, so that the analysis was made from the trouble found and remedied by the employee. The large percentage caused by foreign matter is not unusual and indicates the value of installing mains and services as free from foreign matter as practical. The control of foreign matter in main and services will be detailed in other sections.

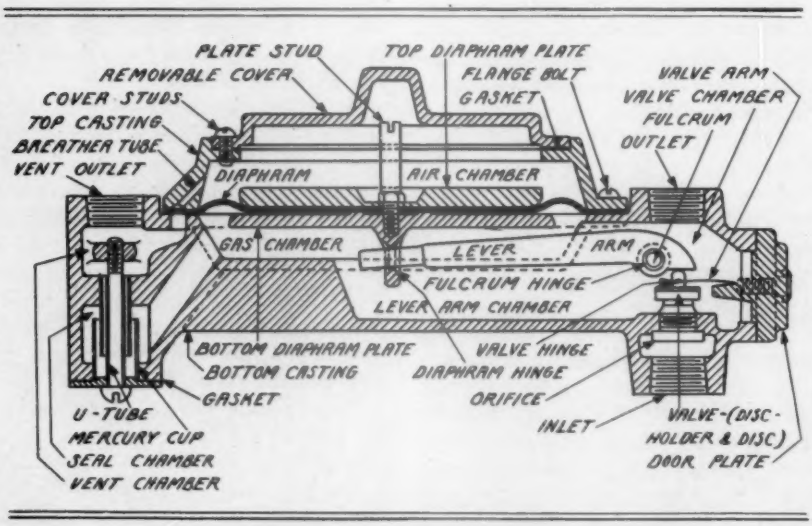


Figure 1—Sectional View of Lever Arm Governor

Foreign Matter on Disc

The cause of improper functioning should be determined when removing a disc. Solid particles imbed themselves in the disc material and are easily recognized not as to their chemical constituents, but merely as solid matter. Where foreign matter results in a governor blow, changing the disc is insufficient to remove the cause, so the service should be cleaned by running a line of hose from the tee just below the governor to the outside of the building, then turning the gas on and off several times until no dust appears in the escaping gas.

Foreign matter being the principal cause of trouble has prompted methods of preventing it reaching the disc. The only means that has been found economically and practically possible from an installation viewpoint is the insertion of fine mesh screening ahead of the governor. The screen has usually been placed between the halves of a union or an inverted cup shaped screen is forced

into the inlet side of the governor above the screw thread connection. A screen with a sufficiently small mesh to prevent particles fine enough to cause trouble from entering the governor is so small that it quickly becomes plugged by accumulation, as it also retains considerable foreign material that would pass an open valve without becoming embedded in the disc. Gums have the same effect on the screen as solid particles. A decided disadvantage discovered through experience is the accumulation of sufficient material on the screen to temporarily shut off the gas supply, which causes appliances in use to cease functioning. The high differential pressure across the screen gradually forces some of the accumulation through the screen, allowing the resumption of flow without the burners being ignited.

Use of Liquid Scrubbers

Another method of preventing foreign matter entering the governor is the use of liquid scrubbers which are used mostly to prevent gum accumulations, especially where an industrial appliance is controlled by sensitive regulators easily rendered inoperative by gums. The scrubber may be constructed with a glass jar for ease in observing discoloration or foreign matter accumulation, but from the difficulty of securing a tight joint, is more commonly a three or four-inch diameter nipple plugged at one end and the top having two connections the same size as the governor inlet. On the inside of the apparatus one of the connections has a dip pipe extending to within ½" to ¾" of the bottom while the other has no fittings. The gas bubbles through the liquid with which the apparatus is partly filled, since bringing the liquid too close to the outlet would result in the liquid being carried along by the gas. Two or more are often placed in series. The size of apparatus should conform to the flow, as the slower the rate and smaller the bubbles the more intimate will be the contact between scrubbing liquid and gas, resulting in more thorough cleaning. The liquid used depends on the type and state of gum to be removed. The more common liquids used are tetralin, gasoline, benzine, kerosene or even water. The gas will become saturated with the scrubbing agent at the high pressure but will only be partially so after passing through the governor, which is preferable to the scrubbers being placed on the low pressure side with moist gas entering the burner controls. With certain liquids the B.t.u. of the gas will be increased, so that adjustments should be made on all burners after the scrubbers have been operated. The cost of maintaining this method is high, and, therefore, impractical for continuous operation, being used only during periods of intense gum trouble on the system.

Foreign matter accumulating on the disc requires a higher pressure on the outlet to completely shut off the flow. This forces the disc against the orifice seat more than usual and results in a depression and sometimes cutting of the disc material by the orifice. The depression becomes deep quickly in high leverage ratio governors and occurs after prolonged subjection to higher lockup pressure on low ratio governors. As this depression becomes deeper it affects the functioning of the governor, particularly at low flows, one indication often being repeated complaints of extinguished or poorly functioning pilots or variations in the flames of partially turned on burners. Experience in the characteristics of burner flames will often result in immediate governor inspection rather than attempting to find causes of complaints in the appliances.

Gum Troubles

In manufactured gas systems gums almost equal foreign matter in their effect on house governors. Many governors will continue to function, especially where there are no pilot lights, until they have become so full of gum that the flow of gas is completely shut off which is particularly true on toggle types. Gum accumulations to the extent of shutting off gas flow account for a small fraction of the total causes of trouble from gums. A slight amount of the gum accumulating on the disc, being first deposited in radial lines, followed by a complete covering of the disc from the orifice to the edge of the disc, will result in extinguished pilot lights. Here again the service should be investigated and any accumulation of gums or liquids removed before the disc is replaced, and the governor returned to operation. The distinct difference in the servicing of high and low pressure systems is illustrated by the difference in the manner of treating a complaint, as in high pressure the governor must be remembered even when servicing appliances.

Effect of Porosity

In distribution systems the lighter liquids such as water, drip oil, casing head gasoline, etc., carried by gas seldom are allowed to exist in quantities harmful to a governor. Condensates are more apt to cause trouble by dissolving material used in tanning, or filling the pores of the disc or diaphragm leather and leaving it porous. This porosity of the disc material may cause governors to weep, while porous diaphragms allow gums to pass through, which at first slightly increases the lock-up pressure of the governor due to the added weight above the diaphragm, and may finally increase the lock-up pressure to the blowing point as the gum accumulates and stiffens.

Removal of foreign matter and repair of the governor are not difficult when foreign matter is definitely the cause of blowing, but the small percentage of blows where the disc is in apparently perfect condition sometimes calls for considerable ingenuity on the part of the service man. In certain types of governors it is possible to insert the valve upside down due to design and it may function for an indefinite period. The position of the disc, where it is possible to insert the same incorrectly, should be observed when removing. Figure 2 shows typical faced discs in which the depression caused by the orifice is in apparently excellent condition and free from foreign matter. However, it will be noticed that the depression is off-center in a few which may not cause immediate blowing, but frequently careful examination will disclose that this fault has allowed a slight movement of disc with respect to the orifice and the governor was unable to make a second seat in the disc.

It will occasionally be found that these governors can be made to lock-up properly by moving the disc so that the orifice and depression in the disc are again concentric, proving double seating as the reason for blowing.

Disc 1 in Figure 2 caused a governor to blow due to the cracked facing which appears as a shadow. This crack was caused by the disc being off center with respect to the orifice, which allowed the disc to tip, and it was necessary for the orifice to depress one side of the disc deeper than the opposite, eventually breaking down the facing or the surface of the leather. In each of these cases the cause of eccentricity should be determined and rectified.

Slow Build Up Significance

A governor which continues to have a slow build up after trial with several new discs should be removed and returned to the shop, as the cause may be a porous casting, a leak through the threads of the removable orifice, or defects in the alignment of valve or valve hinge, each of which should be rectified in the repair shop or the governor discarded.

A complaint reporting a leak around a governor, and found on investigation to be drip oil leaking through the flange or one of the joints, is difficult to correct. A flange leak is usually caused by a slight warping of the castings, poor machine work on the flanges or a faulty diaphragm, all of which are more easily rectified in the shop than in the field. Before removing the governor an attempt should be made to prevent the oil leakage by tightening the flange bolts, if loose. There is no satisfactory test for oil tightness, so that ordinarily it is preferable to make repairs in the shop.

When oil leakage occurs around the door plate joint, all of the door plate bolts should be loosened before they are all uniformly tightened, to assure an even pressure completely around the gasket. A repeat complaint may be avoided by installing a new gasket, should the existing one be even slightly damaged. Only a single gasket should be used on any flange, since two or more increase potential sources of leakage.

It is not an unusual experience to find that the cause of a leak complaint is the odor from an open paint can, recently painted articles near the house governor, the stain used on shingles or the tar used on roofs or in cellars.

Figure 2—Discs Removed from Blowing Governors.

A chattering governor is corrected by slightly bending the valve arm or hinge and, where the cover plate is loose, by tightening the cover plate bolts. If these methods do not eliminate chattering, the governor should be removed and sent to the shop with the reason clearly marked and a thorough study made of the valve hinge, air chamber size, breather tube and other features of design, all of which should be called to the manufacturer's attention for permanent remedy.

Governor Installation—The discussion of services included the meter cock, or where there was more than one meter, the shut off, which might be termed the master control. The governor should be located as close to this master control as local conditions warrant. It is not possible to outline a standard installation which could be followed in every instance, but it can be approached and time saved by a standard list of material. Where considerable installation material is drawn from one source, it is an economy of time to have all the standard material placed in boxes by storeroom attendants during spare time and given to the fitter as a unit.

Below is a list of the material ordinarily used in setting a bottom inlet, top outlet governor, with all connections ¾" and where the meter connections are either ¾" or 1". (See Figure 3) The list of material is incomplete for other than small sizes of governors, as the quantity of larger sizes installed does not usually warrant a special withdrawal form. The quantity on the standard list is in excess of average requirements to allow chiefly defective fittings and also provide for an occasional complicated vent connection. If the accounting system requires the separation of the governor from the meter set, the material on the form may be separated into two or more divisions.

Value of Black Fittings

It will be noted that all fittings are black rather than galvanized. On high pressure and on some low pressure lines a defect such as porosity appears immediately on black fittings, but seldom on galvanized ones until after the installer has left the premises.

A typical governor set consists of a street tee in the master control with the run of the tee along the run of the service so that by removing the plug the service may be cleaned by inserting a rod or cleaner.

The bull head of the tee is to the right when facing the service, followed by a street ell and a short nipple about four inches long. On installation the street ell is made up tightly, except for a quarter turn, which leaves the open end facing away from the service. Into this open end the nipple is made up tightly, followed by the governor, after which the street ell is tightened, the additional quarter turn bringing the governor into its proper position. Ending the service sufficiently inside of a wall, to allow swinging the governor horizontally, results in the meter being set too far from the wall. Another disadvantage is that the additional distance from wall to street tee increases the possibility of the service breaking from accidental blows, since the distance adds leverage.

Various modifications of the above method have been used, usually to decrease the number of screw joints and to minimize tampering for the purpose of by-passing. The most common change is the use of a street ell in place of the street tee to eliminate the plug. A plug should be carefully watched, as it may be run completely inside the fitting being plugged so that tightness then depends solely on the joint compound used, which is contrary to good practice. A few cases have occurred where the consumer by-passed a meter by connecting directly into the high pressure, but these instances are rare and there are none on record where the street tee ahead of a governor was used for the connecting link.

The street tee is sometimes installed with the bullhead facing upward, or a street ell is used in place of the street tee. With these practices either a union must be installed beneath the governor or the service extended into the building sufficiently to allow turning the governor in a complete horizontal circle. This method eliminates the semi-swing joint, which facilitates a level set of the governor and requires bending the service or nipple both for leveling the governor and securing a plumb riser to the meter. The lack of a swing joint also increases the possibility of strains being imposed on the fittings underneath the governor, since the swing joint can be used to care for slight angularities in meter or house riser connections.

Use of Vertical Tee

Side inlet governors require more space than those with bottom inlet. In some cases the street tee is installed with the run vertical, which is preferred by some utilities, since the service can be cleaned by placing a receptacle beneath the tee to catch foreign matter, by way of removing the plug and opening the master cock. The advantage of directing the foreign matter adds the disadvantage of making it impossible to run a rod or cleaner directly into the service.

To insure against accidents, a high pressure service should never be carried any distance inside of a building before installing the governor. It is common to find that an owner has enlarged the size of his basement where a governor is usually placed, which leaves the governor a considerable distance from the entrance of the service. All employees should be instructed to report such conditions, which are remedied by bringing the governor as near as possible to the entrance of the service into the basement and connecting on the low pressure side to the house line. It is not always advisable to attempt to collect this relocation cost from a consumer, as they feel that satisfactory service is rendered without changing the location and are somewhat justified, when it is considered that the reason for the change is protection of the utility from possible damage, not only to their own but also to public and private property, should a high pressure service be broken.

STOREROOM

Date _____ 19 Governor Material

Charge to	Account No.	District	Work Ticket

MATERIAL	QUANTITY Reld.	Rtd.	Used	UNIT PRICE	COST
1" Black Pipe					
3/4" " "					
3/4" " Ells	6				
3/4" " Nipples					
3/4" " St.Ells	4				
1"x3/4" " coup.	1				
1"x3/4" " Ell	1				
1"x1"x3/4" Blk.Tee	1				
3/4" Black Plugs	2				
1" " "	1				
Meter Bar	1				
2 Lgt.Meter Nuts	2				
2 Lgt. " swivels	2				
1" L.P. " cock.	1				
3/4" Blk. St.Ells	4				
3/4" " " tees	2				
3/4" " ells	4				
3/4" Galv. tee	1				
3/4" Ground joint	2				
Meter reducers 5x3	2				
3/4" H.P. Coup.	2				
1" x1" Coup.					
Governor Size 1	1				
Priced	MATERIAL COST				
Checked	HANDLING 4% OF ABOVE				
Fittings	TOTAL				

Above Material Received By _____

Delivered By _____ Storekeeper

Store Order NO. _____ DATE _____ 19

Copy for _____

Figure 3—List of Material Used in Setting Governor. (Actual Size of Form, 5 by 8 inches)

Some utilities place a union ahead of the governor, with the idea of facilitating removal. Experience has proved that whether the union is of the ground joint or gasket type, it is the source of complaints from leakage of both gas and drip oil.

Fittings ahead of a governor should be placed with more than usual care to prevent joint compound from entering the pipe, fittings or governor, where it would be detrimental to the operation of the valve.

A governor should be installed as nearly horizontal as possible, which is easily accomplished when a street tee and street ell are used, as they provide a semi-swing joint which can be used to overcome angularity in the service resulting from grading. If the threads in the inlet of the governor are crooked, the governor should be removed and examined to see that the defect is only in angularity of threads and not in the casting. If the casting is normal, a slight angularity of the governor would not be detrimental to proper functioning or appearance. The use of a spirit level to secure extreme accuracy is unnecessary, but a deviation sufficient to tip the diaphragm plates would affect control and sensitivity.

The installation of a union between the governor and the meter header simplifies removal of the governor, but many utilities consider that the ease of tampering provided by a union at this location more than offsets the advantages. A union should be used where there is more than one meter on a header. When governors are installed in parallel, to provide continuous service, unions are necessary and must be installed ahead of the shut off on the outlet side of each individual governor.

A union placed on the vent line near the governor will facilitate removal of the governor. This union

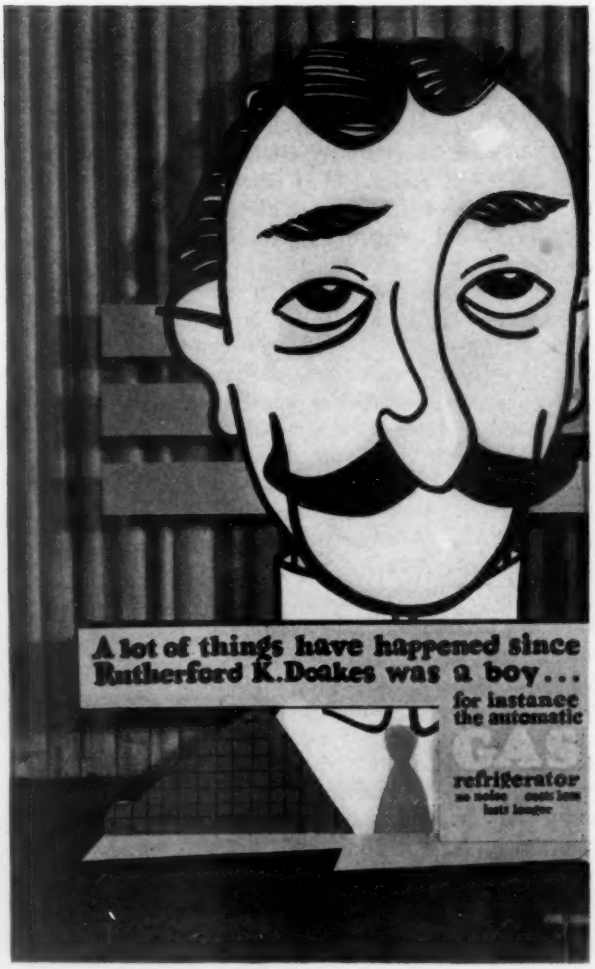
(Continued on page 52)

Is Copy Important in the Window Display?

YES!

Says Stuart Bratesman,

Manager, Display Dept., Boston Consolidated Gas Company



TOO many people place little, if any, importance on the effect of good copy on the average person. It is true, that in window display advertising, more than in the printed type, copy comes second to the instant flash of brilliant color, an original idea and a crisp illustration. But, copy has a place in the layout; it is a sort of "mopper-up"—it conveys the lasting thought to the reader.

As a person turns away from a window advertisement what is it that lingers longest in his, or her mind? If the display has been thoroughly read, we'll venture to state that some feature of the appliance advertised further explained in the copy is the thought retained. When advertising agencies plan a big printed campaign to advertise some new product, no little time and thought are given to the copy of the entire series of advertisements. Why shouldn't careful planning and selection enter into the painted display field as well? After all, we're talking to the same public that read the newspapers and magazines and advertising is the same, under the surface, no matter what the media.

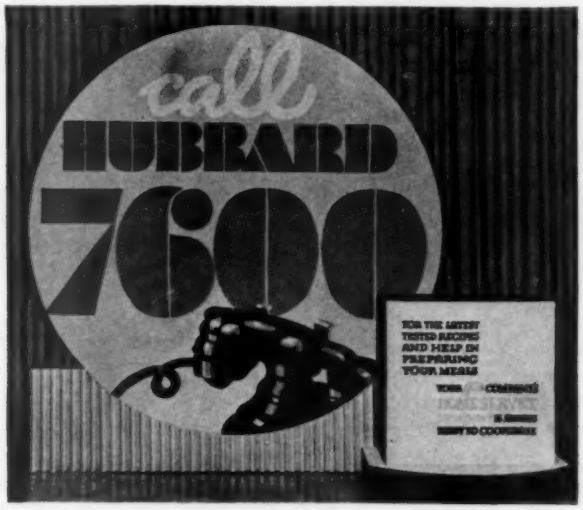
The day has long since past when a mere statement of name and price will sell gas service or gas appliances in window displays. The public must be *made* interested in the gas company by progressive advertising that arouses interest, not dreary statements of facts that everybody knows, and cares little about. New thoughts, presented in modern window displays, are always sure fire sales-builders. Good copy plays its part in presenting these thoughts.

Three examples of different copy treatments and their adaption to gas

window displays are shown on these pages. Notice that in none is the copy ordinary, that is, a plain statement of facts.

Interest is built up in the house heating display by having the characters of the illustration speaking the copy. This type always proves interesting as it warms up the reader and makes the final sales message more lasting. The copy in the Home Service display is written directly *at* every woman in the area served by the gas company using this advertisement. Very light and facetious is the copy in the refrigeration set. In keeping with the hilarious cartoon head, the copy ties in with the thought behind this display.

Don't let anyone tell you that copy isn't important in *any* advertisement. The gas industry is just crying for new ideas in its advertising. Bright, sparkling, human-interest copy is one medium in which to present them. Today's competitive advertising demands up-to-the-minute methods of *attack;* don't neglect the copy in your window displays.



Gas Company Statistics For January, 1933

REVENUES of the manufactured and natural gas industry aggregated $69,997,600 for January 1933, as compared with $74,094,100 for January 1932, a decline of 5.5 per cent.

The manufactured gas industry reported revenues of $34,288,400 for the month, a drop of 8.8 per cent from a year ago, while revenues of the natural gas industry totalled $35,709,200 or 2.2 per cent less than for January 1932.

Sales of manufactured gas reported for January totalled 32,323,900,000 cubic feet, a decline of 6.9 per cent, while natural gas sales for the month were 90,047,200,000 cubic feet, a drop of 1.1 per cent.

As of January 31, 1933, total customers of the industry aggregated 15,376,500, as compared with 15,985,200 on the corresponding date of the preceding year, an indicated loss of more than 600,000 customers during the twelve month interval.

The relatively smaller decline in sales and revenues reported by the natural gas industry resulted from a gain of 2.4 per cent in sales to domestic users and an increase of 5 per cent in commercial sales. This was more than offset however, by declines in sales of natural gas for industrial purposes.

The only gain reported by the manufactured gas industry was in the sale of gas for househeating, which increased nearly 6 per cent for the month. Manufactured gas sales for other domestic uses, such as cooking, water heating and refrigeration, showed a loss of 7.4 per cent, while sales for industrial-commercial purposes declined nearly 11 per cent.—*Paul Ryan, A. G. A. Statistician.*

Marketed Production of Liquefied Petroleum Gases

1927, 1,091,005 gal.; 1928, 4,522,899 gal.; 1929, 9,930,964 gal.; 1930, 18,017,347 gal.; 1931, 28,769,576 gal.; 1932, 33,630,236 gal.

These gases included are propane, butane, pentane and propane-butane mixtures. The gain recorded for 1932 was principally within the fields served by butane, especially for gas manufacturing purposes. The demand for propane was only slightly larger than in the preceding year. The distribution of 842,126 gallons of pentane is included in the quantities reported under pentane and propane-butane mixtures. Nearly all of the liquefied petroleum gases marketed during 1932 were produced at natural gasoline plants. Some companies, however, reported production at refineries.—*U. S. Bureau of Mines.*

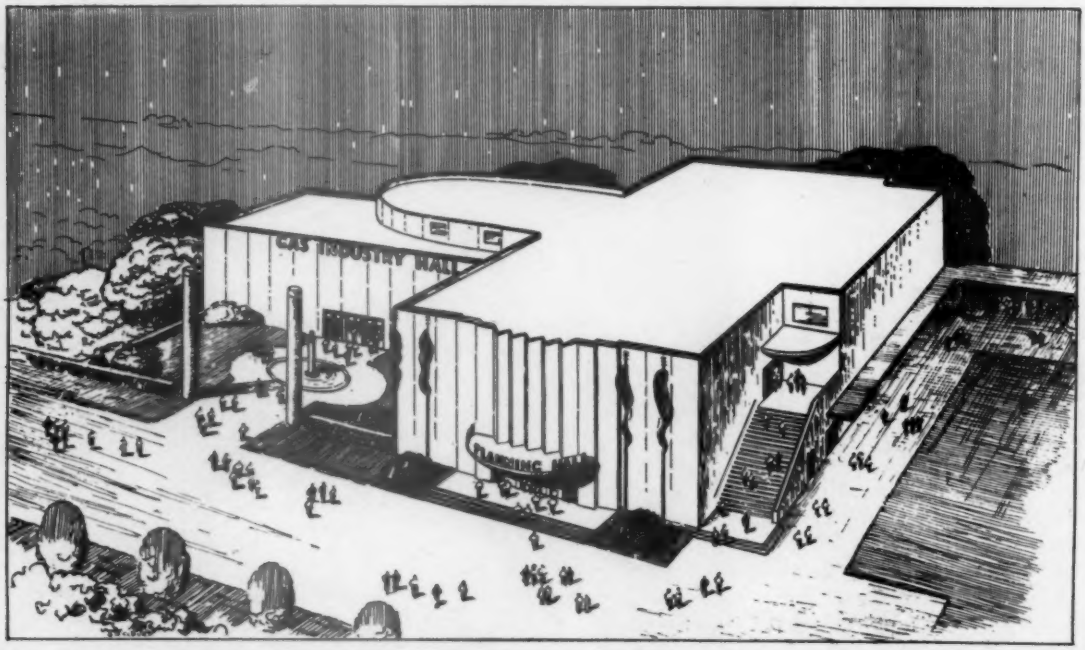
GAS-COOKED FOODS *Will Tickle the Palates of Millions at the Chicago Exposition*

By GAS TRONOMY

A CENTURY ago a handful of soldiers gathered at mess in Fort Dearborn to partake of their rations of poorly cooked bread, tough meat, a half gill of whiskey and a dash of vinegar, while yowling redskins outside the stockade drew avidly on their war pipes and whetted their tomahawks. During the coming exposition in Chicago, millions will saunter peacefully from building to building viewing the record of progress of a great nation, the while sharpening appetites which will be satisfied to the utmost by gas-cooked viands—from the succulent and satisfying "hot dog" to the gout-provoking but delectable breast of guinea hen. And, as they tranquilly ply knife and fork on the more expensive dishes or mayhap crunch audibly on a pretzel with a tankard hard by, there will be no distracting din to divert them; rather, the hum of America on the march will sound a prelude to a new and greater era. But let's see the restaurant line-up which, as stated, will be supplied with the perfect fuel carried through pipes of peace.

Bird's eye view of A Century of Progress, Chicago's 1933 World's Fair. A portion of the grounds are in close proximity to the Peoples Gas Light & Coke Company building

Facilities for feeding an estimated daily attendance of 200,000 persons are well advanced and restaurants, large and small, sandwich shops, potato chip counters, hot dog stands, coffee and doughnut dispensers, rotisseries, cafeterias—all will use gas fuel in the preparation of food for the hungry multitudes. It appears that everything from grilled lake fish



Home Planning Hall at coming Chicago Exposition. To the south is the Gas Industry Hall annex. Developments in heating, plumbing, air-conditioning and household equipment and appliances will be featured in the building as a whole

to a fried egg will be done to a turn over a gas flame.

Reliance upon gas fuel represents no late move upon the part of the fair management or those in charge of concessions. The first structure erected on the exposition grounds, the Administration Building, was opened in 1930, and gas fuel has been used exclusively in this building for the preparation of food for the officers and employees of the exposition's managerial staff, and for space heating, water heating and incineration. The gas heating installation is a sizable one and consists of three twenty-two section Bryant boilers with a connected steam radiation load of 17,808 square feet.

Two of the largest eating palaces, both reminiscent of pre-Volstead days, are the Blue Ribbon and Old Heidelberg restaurants. The Blue Ribbon will have a dining capacity of 17,500 persons daily and will be operated for Pabst and Company of Milwaukee. It will have a gas-equipped kitchen consisting of an eight-section range, stock kettle, vegetable steamer, griddle, bake oven, bain marie, steam table and coffee urns.

Thy Sons Will Ne'er Forget

Old Heidelberg, serving 10,000 daily, will have an all-gas kitchen. Hot water requirements will be provided by three No. 8 Ruud instantaneous heaters. Seven Humphrey unit heaters will furnish space heating for the building.

Eitel's Incorporated, a well-known Chicago company, has started business in a large concession where they are feeding the workers employed on the fair grounds. They have installed an all-gas kitchen and are heating their premises with a large sized Surface Combustion unit heater. They have also purchased a gas-fired rotisserie.

A reproduction of old Fort Dearborn showing ground inside.

Coffee and Doughnuts

Twelve stands serving coffee and doughnuts and operated by the Downey Flake Company in conjunction with Chase and Sanborn, will use gas-fired equipment for coffee brewing and water heating.

The Sears, Roebuck building restaurant will be operated by the B & G Sandwich Shops. Preliminary plans call for a gas-equipped kitchen with a four section range, three portable bake ovens, two automatic water heaters (one for the building and one for the kitchen which will serve as a booster heater for the latter's hot water demands), and miscellaneous appliances. Gas is also contemplated for space heating requirements.

The Ann Rutledge Tavern, now in operation, has found its present set-up too small. Plans are being prepared for the enlargement of their all-gas kitchen and dining room.

The Adobe Barbecue Sandwich Hut, to be located in the Midway Section, contemplates a small kitchen and will use gas in the range, bake oven, water heater and unit heaters. This project is now under consideration.

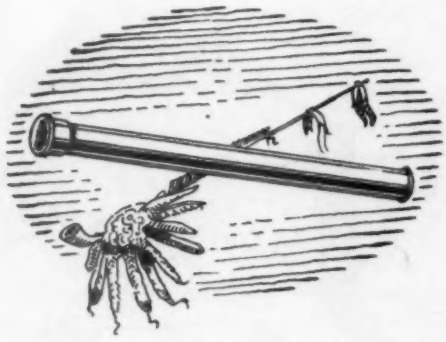
The Crown Food Company will operate 75 sandwich stands, and will use Ruud Autohot Instantaneous Heaters for their hot water demands. This concessionaire has authorized the Stearnes Company to build special griddles for all their stands. Specifications of the burner design contemplated have been submitted to The Peoples Gas Light and Coke Company for approval.

Libby, McNeill & Libby contemplate the erection of 15 stands where potato chips and tomato juice will be served. They will use gas-fired potato chip fryers.

An All-Gas Job

Construction will be under way shortly for the Vienna Restaurant. Details are not available as yet, but tentative plans call for an all-gas job, including water heating and space heating.

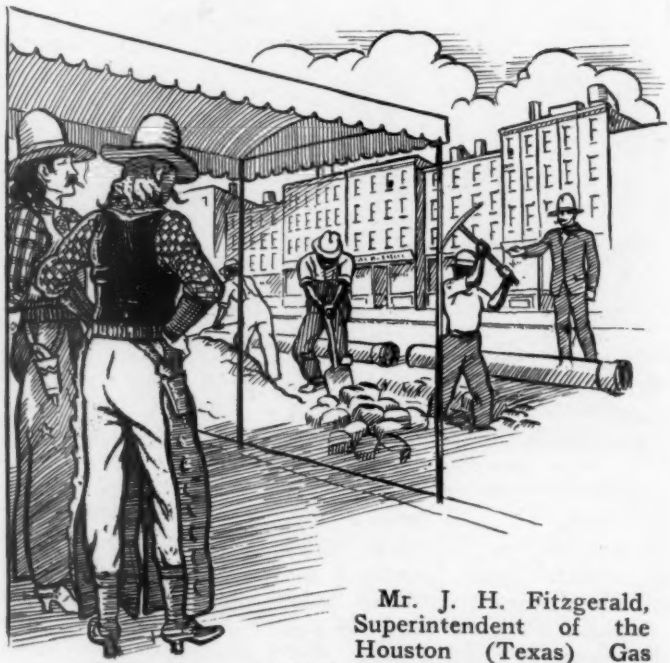
Additional gas installations are pending in other eating places on the fair grounds, and negotiations are under way for using gas in some of the "live" industrial exhibits.



Can You REMEMBER When?

by E. Eisfeller

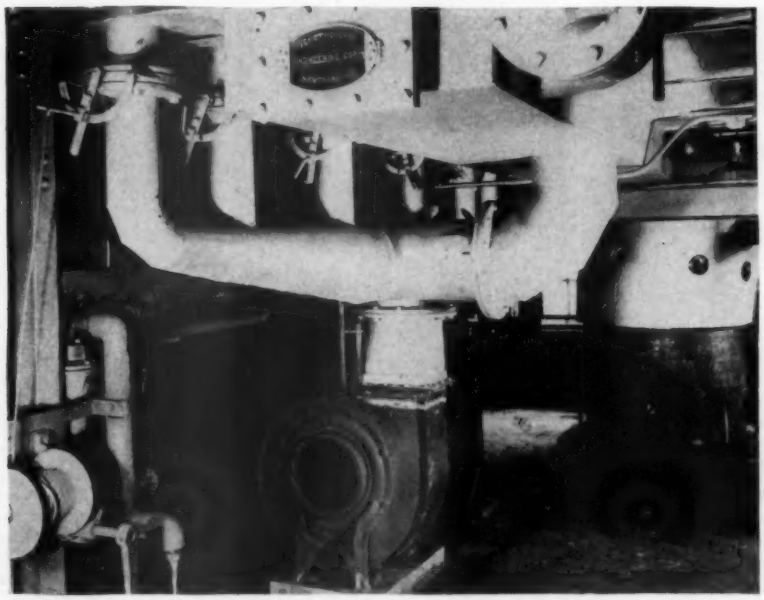
A notice to this effect was published in the Fishkill (N. Y.) Daily Journal of the 3d inst.: "There will be no prayer meeting at the Presbyterian church to-night, on account of no gas."—*American Gas Light Journal, March 13, 1893*



Mr. J. H. Fitzgerald, Superintendent of the Houston (Texas) Gas Light Company, is about to put down one mile of 12 inch feeder main through the central part of the city, the work to be completed during the latter part of April.—*American Gas Light Journal, March 27, 1893*

We are indebted to Mr. R. M. Searle, of the Westchester Lighting Company, Mount Vernon, N. Y., for the illustration herewith showing the use that the Company made of a "real live camel," during a circus parade in Mount Vernon, as a means of showing that which the Company had for sale. The "ad" attracted great attention.—*American Gas Light Journal, July 27, 1903*

The WASTE HEAT BOILER *in the* SMALL GAS PLANT



View from below of the tar fired combustion chamber and base of the Semet-Solvay Waste Heat Boiler.
The blower and manifold through which air is supplied for burning the tar and cooling the brick lining of the chamber is shown. At the right, rear, is the base of the waste heat boiler.

By means of a tar burning combustion chamber used during the period of gas making, and utilization of stack gases during the blow run the gas plant at Norwich is adequately furnished with steam

By HENRY M. RILEY
Editor, *American Gas Journal*

LIMITED space and the intermittent nature of the supply of heat from the superheater stack valve are the two main obstacles to be surmounted when a waste heat boiler installation is under consideration for the small water gas plant. As regards the latter condition, the problem is presented in its most difficult aspect when only one water gas set is making gas.

The waste heat boiler installation recently completed and put into service in the gas plant of the City of Norwich, Conn., Gas and Electric Department by Semet-Solvay Engineering Corporation, shows how the problems of lack of space and varying heat supply from the water gas set were solved.

Briefly, although the Norwich generator house with its two water gas sets and accessories offered but little spare space, a careful study of existing layout and considerable planning enabled the contractors to locate the boiler with a minimum of crowding. The accompanying photographs give a fair conception of how the installation was fitted into the existing scheme of affairs.

In the case of this plant the gas making is taken care of by two water gas sets: one a U.G.I. unit, 7 feet 6 inches in diameter; the other a 6 feet 6 inches diameter Gas Machinery Company set. However, the city's demand is being taken care of by one machine's operation. Consequently, the heat available for producing steam is intermittent, and in order to insure a steady thermal supply, an auxiliary heat producer had to be provided. This called for the installation of a tar burning combustion

chamber* which is automatically put under fire during the make and switched off the line—at a lessened rate of tar burning—during the blow. Before proceeding with a description of this equipment it would be in order to say that, obviously, a saving in steam costs was the motivating factor back of the installation.

Originally, the gas plant received its steam from the electric department and frequently, when current was being generated by hydro-electric units, the boiler plant was operated solely for supplying steam to the gas department. The yearly charge for this steam was approximately $14,000; against this the following figures were weighed:

Tar for combustion chamber 240,000 gals. @ 2.25c per gal	$5400
Water 353,000 cu. ft. @ 60c per M cu. ft.	212
Interest and depreciation on $22,500 @ 11%	2475
Maintenance 300 days @ 250 per day	750
Yearly cost	$8837

On this basis the proposition was considered quite attractive.

As stated, there are two water gas sets available and either has sufficient capacity to take care of the city's needs, the average daily output running in the neighborhood of 500 M cubic feet. Bituminous coal is the solid fuel used and enrichment is taken care of by straight water gas oil. (Bunker C Oil is now under consideration.) Gas of an average heating value of 530 B.t.u. per cubic foot is produced and the present operating schedule is 2 minutes blow and 4 minutes make. Due to a large storage capacity, it is only necessary to make gas during the six week days, and at the rate of eight hours a day.

The accompanying line drawings depict the essential hook-up of the installation. In describing the flow of thermal energy and the synchronous functioning of the various parts and accessories, let us assume that gas is being produced by the set which includes superheater G'. Also, we will start from the condition of the set being under blast.

The hot blast gases pass through pipe P to pipe P', thence through goggle valve g to pipe P_2 and finally to waste heat boiler b. Passing down through the boiler b the gases make their exit through boiler stack S. Meantime, let us see what is happening in the case of the combustion chamber D. Here the tar burner F is operating at ten per cent of its maximum burning capacity and, with butterfly valve C closed and motor driven blower A merely turning over on itself, there exists in the combustion chamber sufficient back pressure to prevent any of the hot blast gases from finding their way back to this point.

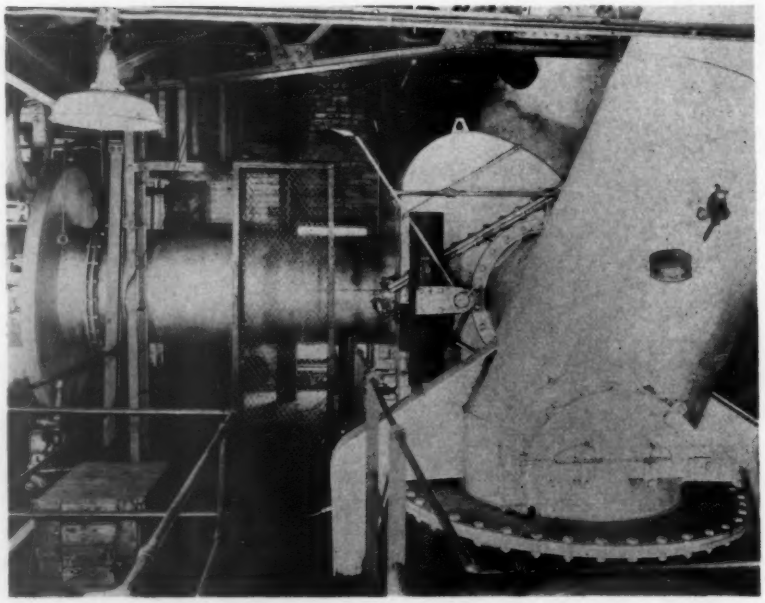
At the end of the blow the gas maker turns on the steam for gas making purposes and automatically, through the medium of hydraulic pressure, goggle valve g closes. Simultaneously, hydraulic valves in the tar lines are opened to effect a change from delivery of 10% to full delivery capacity and butterfly valve C opens. (The tar, which has been preheated in tar heater H, enters the burner at about 100 deg. F. and at a pressure of 35 lbs. per sq. in.; steam for atomizing enters the burner at 25 pounds gage pressure.) All of these movements are synchronous and automatic. At this stage, air from blower A enters manifold M and thence to ducts 1, 2, 3, 4, 5, 6. From these ducts the air is constrained by the nature of the construction of the Dutch Oven D to first circulate through an air space which bounds the arched top, the two sides and the front and back of the oven. By following such a route the air is both preheated and tempers the brickwork of the oven.

Next, the air enters a rectangular chamber Z and proceeds through butterfly valve C, as secondary air, to meet the tar flame issuing from burner F. Preheated air is also being supplied through pipe O as primary air to the tar burner F. Finally, these products of combustion make their exit from the top of the dutch oven D and travel through pipe P_2 to waste heat boiler b. Provision is made for injecting a stream of cold air into the rear end of firebox, to cool the explosion door and dilute the products of combustion.

When the make run has been completed and the blast turned on, goggle valve g is simultaneously and automatically opened, likewise butterfly valve C is closed, and the cycle proceeds as previously outlined.

It must be remembered that ducts 1, 2, 3, 4, 5, 6 have no points of in-

Built under the McGee patents



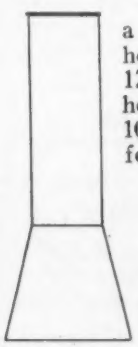
A portion of the operating floor at Norwich.
The horizontal pipe at the left connects one of the water gas machines with the waste heat boiler. At the extreme left may be seen the brick-lined ring which is inserted in the line when this machine is making gas. When cut out, a slip blank fits into the line, cutting off the superheater of this machine. Next in line is the expansion joint.
The wire netting is a safety guard for the counterweight of the 24-inch Semet-Solvay goggle valve, the exterior of which may be seen at the center, rear. In front of the valve is its hydraulic cylinder, which operates from the hydraulic system of the machine.
The large brick-lined pipe at the right foreground is the connection between the tar fired combustion chamber and the waste heat boiler.

gress to the interior of the dutch oven D; they only are in circuit with the air space surrounding the inner wall which is composed of fire brick, high temperature insulation and asbestos insulation.

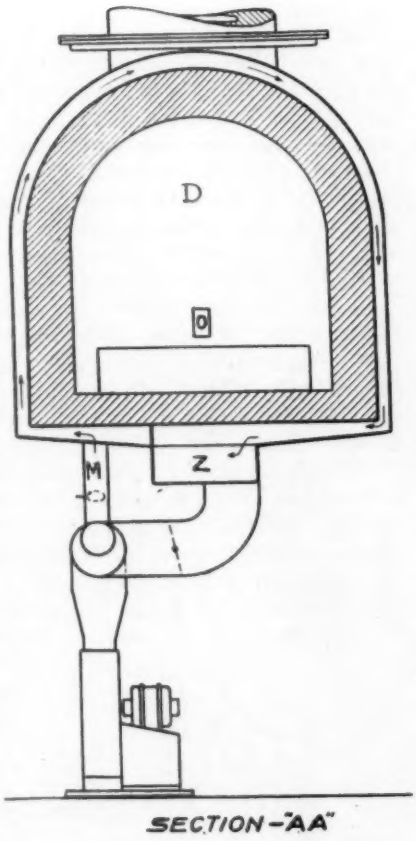
The function of vent V is to release air from the blower to the atmosphere during the time that the blast from the superheater is going through the waste heat boiler. This permits the air cooling of the tar burning chamber to continue without interruption. It also maintains a suitable volume through the fan and so keeps up desired pressure.

It should be mentioned that, when it is found desirable to operate set G, slip blank B^1 is closed and slip blank B opened.

The temperature of the blast gases leaving the superheater average 1,350 deg. F., and the stack temperature of the boiler runs about 450 deg. F.



The boiler b has a rating of 173 horsepower, with 1730 square feet of heating surface in 100-3 inch by 22 feet fire tubes.



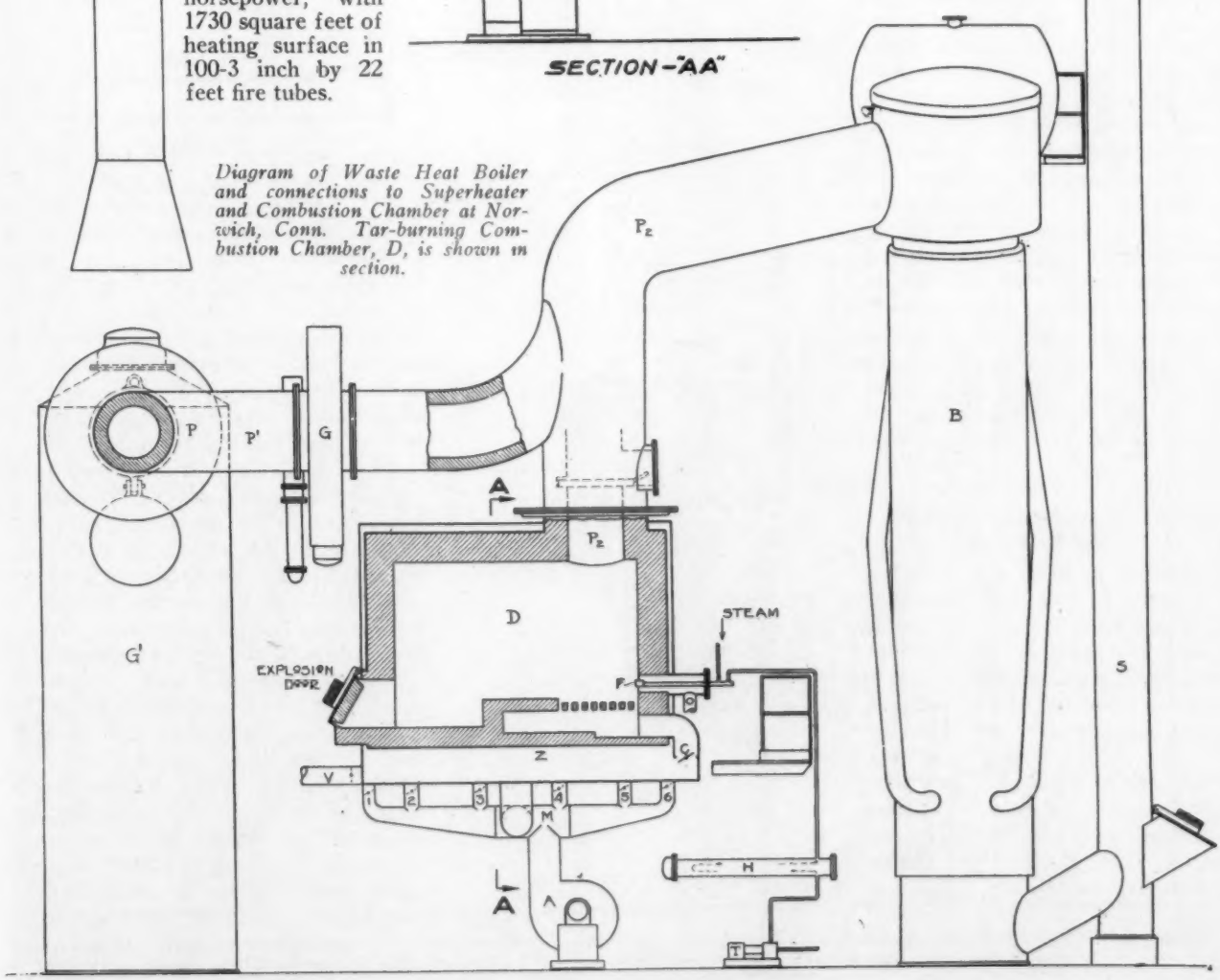
The Semet-Solvay waste heat boiler at Norwich contains a number of features in its design which depart from earlier types generally in service.

The main tube section is tilted, which causes the steam to be released through an outlet to the steam drum at the highest point in the tube section. This prevents the formation of any steam pockets.

The bent tubes which are the outlet for steam from the boiler to the steam drum are flexible. They discharge the steam ABOVE the water line of the drum. This assures quick release of the steam and also keeps the steam drier than it would otherwise be. It also prevents surging of the water line. The size of the steam drum is ample for the amount of steam made and for quick liberating of steam.

The water return tubes leading from

Diagram of Waste Heat Boiler and connections to Superheater and Combustion Chamber at Norwich, Conn. Tar-burning Combustion Chamber, D, is shown in section.



the drum to the base of the boiler are also flexible. They travel around the outside of the boiler to provide an entrance at the opposite side of the drum, at the base. This arrangement provides a cross flow of water across the tubes, preventing any "dead" pockets in the heating surface.

About two wheelbarrows of breeze have been cleaned from the boiler in one and a half month's operation. While the combustion chamber may require rebricking from time to time, it is expected that this will be about on the same basis as rebricking a regular boiler.

There are no extra men required by reason of this installation, the gas maker being quite able to look after conditions in conjunction with his regular work. As a matter of fact, the gas maker merely looks at the regulation of the various valves, etc. about every two hours.

As regards tar consumption, results to date seem to indicate that the quantity incident to gas production will not be exceeded by that necessary to operate the combustion chamber; at present about 0.4 gal. of tar are derived per thousand of gas made. In the combustion chamber, at times a rate of 90 gallons of tar burned per hour is reached.

In the event the flow of tar through the tar pump T is interrupted or if the blower A stops, a conveniently located bulb on the operating floor lights and a fog horn sounds; thereby the gas maker is enabled to take care of the situation with dispatch. Each morning when starting up, two gas pilots in the Dutch Oven are ignited and then gas oil is sprayed in for a period and finally the tar is turned on. About an hour is given to this starting procedure; at the end of this time the gas maker starts his day's operations.

The superintendent, Mr. W. P. Shanley, plans to make the waste heat unit still more automatic by installing a boiler pressure regulator to maintain uniform steam pressure, and a wall temperature regulator on the tar combustion chamber. By use of the latter regulator, if the wall temperature gets too high the tar supply will be cut off. Both of these regulators will work in synchronism.

In the event the Norwich plant finds it necessary to put the two water gas sets into operation, the waste heat boiler operation could be synchronized so that both machines could be blasted through the waste heat boiler. This would merely call for the installation of a second goggle valve.

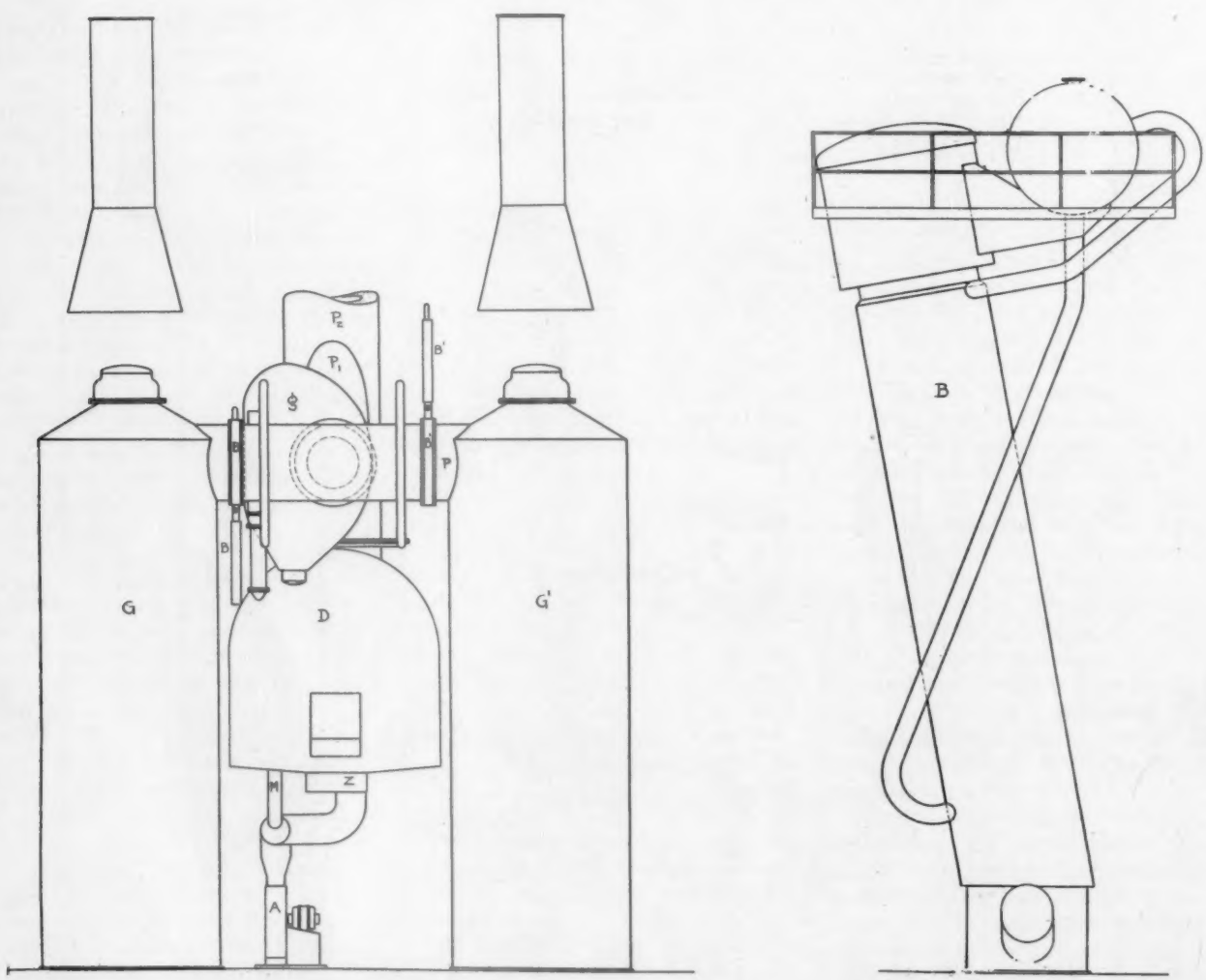


Diagram of Waste Heat Boiler, Combustion Chamber and two Water Gas Superheaters, together with their piping and other connections, at the Norwich plant. The tar-burning Combustion Chamber, D, is shown in its end view.

Technical Digest

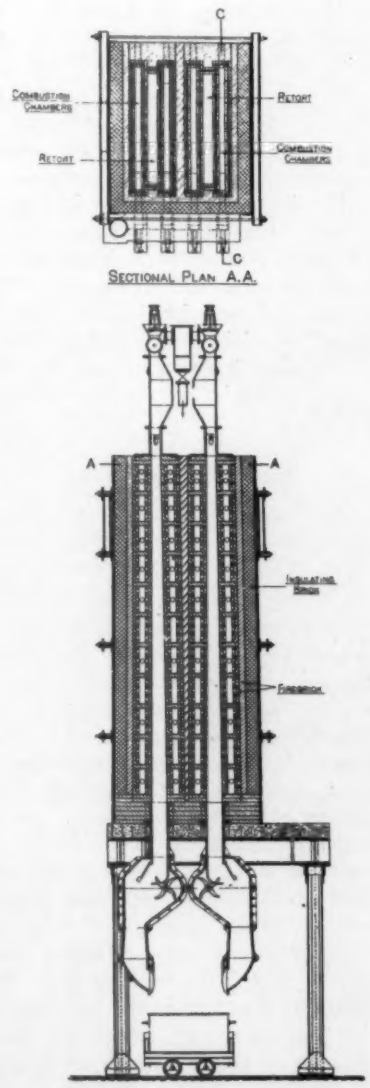
METHYLENE BLUE IN CO POISONING

Death from carbon monoxide poisoning may be avoided by the injection of a dye-stuff, methylene blue. Carbon monoxide in the system prevents the tissues from obtaining oxygen from the blood and the methylene blue transfers the oxygen to the tissues because it is an oxidation-reduction indicator and thus is able to take up oxygen or give it up rapidly. Intravenous injection of fifty cubic centimeters of a one per cent solution in water of methylene blue has been found effective, oxygen being freely used at the same time.

LOW TEMPERATURE CARBONIZATION

Latest types of settings for two brick retorts are described. Coal is carbonized continually in a vertical firebrick slot retort, seven inches wide at the top, widening to eleven inches at the bottom in a height of 21 feet, and six feet six inches in the long dimension. Operation of brick retorts proved successful. Good type of low temperature coke and a satisfactory yield of low temperature tar and also of gas. There is no loss due to gas leakage. Cost of building the retort is low. Details of results are given covering a wide range of coals. Type and size of coal have a pronounced effect upon the throughput and in general the higher will be the yield of tar. That is to say, certain non-caking coals which do not break down during carbonization will give a very high throughput, a good yield of tar and a satisfactory coke. There are, however, very few non-caking coals which do not break down from the nut form on carbonization and so create a large quantity of breeze and dust. In the case of metal retorts, the temperature must be kept within a few degrees of the destruction limit to obtain a good commercial throughput. This difficulty does not occur with the brick retorts. The direction of flow of heated gases around the retort has been reversed, so that instead of sending away flue gases from the top of the retort at a temperature of up to 1100 degrees C, the gases finally pass away from the bottom at a temperature of 600 degrees C. The success of the retorts appears to lie in the very high heat input in the first few feet of the retort.

—Technical Paper No. 35; Fuel Research, Department of Scientific and Industrial Research, London.



ASH IN COAL AND GAS YIELD

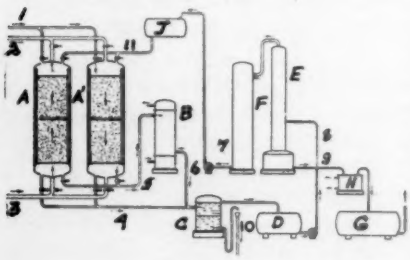
The thermal yield of gas increases as a general rule as the purity of the coal used in the gas making process improves. Very often it surpasses the calculated yield. In certain instances, however, the yield decreases due to purification due to loss of calorific power. The differences between the actual thermal yield of gas and the calculated yield are due to the properties of the refuse eliminated during washing the coal. This refuse matter contains carbon, the absence of which in the enriched coal may modify the results of carbonization. The coke yield is generally close to the calculated yield. Its hardness first increases with the degree of purification; it passes through a maximum and then decreases. Here again this appears to be due to the carbon which is removed in the refuse. A study of the ash, which was undertaken for the purpose of determining the possible catalytic action of one or another of the constituents, did not reveal any apparent relation between the yields of gas and coke and the mineral substances present. In the majority of cases the purification of the coal is accompanied by an increase of the total content of basic oxides in the ash. Decrease in the percentage of oxide of iron is generally compensated by an increase in the percentage of alumina.

—N. J. Ivison; Fuel, volume 11, pages 214 to 217.

PHENOL FROM CRUDE AMMONIA LIQUOR

Details are given of a number of operating installations for the removal of phenol from crude ammonia liquor by means of activated carbon. The accompanying illustration shows a simple and effective installation for this purpose. There are two absorbers (A) and (A′), which are filled with activated charcoal. The phenolic ammonia liquor enters through the line (3) into absorber (A), while (A′) is being treated with steam to regenerate the activated charcoal. Each absorber contains about 4400 pounds of charcoal. The ammonia liquor is sprayed

into the absorber (A) and the activated carbon removes the phenol with the aid of benzol, which flows down through the upflowing stream of liquor, entering through the pipe



(11). The mixture of benzol and phenol is removed at the bottom of the absorber (A) and flows into the water separator (C), where the water is separated and flows off through the line (10), while the mixture of benzol and phenol flows into the tank (D). From this tank the mixture is pumped through the line (8) into a distilling column (E). The benzol is distilled off and is condensed in the condenser (F). The benzol is then pumped through the line (7) into the tank (J) from which it is fed to the absorbers to perform its work over again. The phenol is removed at the foot of the distilling column (E) through the line (9) to a cooler (H) and thence to a tank (G). In regenerating the activated charcoal, steam is fed into the absorber (A) through the line (1) and the mixture of benzol and steam is removed at the bottom through the line (5) into the condenser (B), the benzol-water mixture flowing through the line (6) from the bottom of the condenser into the water separator (C). The ammonia liquor, which has been freed from phenol, is removed from the absorber (A) through the line (2). Good results are obtained with this installation at low cost. *—Dr. F. Sierp; Das Gas and Wasserfach, volume 76, 1933, pages 105 to 109.*

GAS IMPURITIES AND METERS

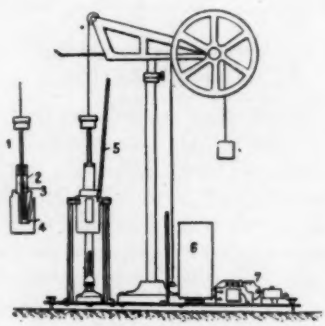
Judicious choice of metals and alloys in the construction of meters results in avoidance of corrosion. It is however much more difficult to protect the membranes and leather parts of the meters against impurities remaining in the purified gas. The most dangerous substances include benzol, naphthalene and anti-oxidizing ingredients, ammonia, sulphuretted hydrogen, iron salts, water vapor and oxygen. Hydrocarbons act directly by lowering the mechanical strength of the leather, and indirectly by dissolving the substances that have been used in impregnating the leather. Ammonia and sulphuretted hydrogen act on the partially extracted membranes by neutralizing the tannins and reducing the leather to the original hide state. Thorough impregnation of the leather with fatty acids retards this action by the formation of an ammonia soap, but facilitates it as soon as saturation is attained. Ammonia soaps are easily entrained in the moist gases. Iron is contained in the gas principally in the form of volatile compounds. It reacts with tne fatty acids and tannins, resulting in the formation of black compounds, the action of which is analagous with that of ammonia, in that they both destroy the leather. Steam or water vapor is particularly destructive in the case of gases containing little fatty substances. It causes rapid oxidation of the gas mains in the presence of ammonia and oxygen and consequently results in the formation of oxide dust. Water vapor in the gas often causes contraction of the leather which produces inaccuracy in the operation of the meter. The best remedy consists in purifying the gases by refrigeration and producing gas as free from oxygen as possible. *—O. Knoblauch; Das Gas und Wasserfach, volume 75, pages 531 to 532.*

PIETERS COKE OVEN

The coke oven consists of two chambers. A horizontal section is rectangular in shape. The chambers are 45 feet high, of which 30 feet is for the carbonization of the coal and the remaining 15 feet for the cooling zone at the bottom. Each chamber is provided with a certain number of conduits through which cold air is passed for recovering heat from the coke which is being cooled. The preheated air is mixed with carbon monoxide from the distillation of the coal and is burnt in special burners. On the other hand, the gases of combustion, while passing in front of the cold air conduits, release a good part of their heat, decreasing in temperature from 1200 to 200 degrees C. The crude fuel, which may be a mixture of non-cooking coal, lignite and the like with fatty coal or bitumen, is introduced into the upper part of the chambers progressively as the coke leaves at the bottom. *—J. Dubois; Przemysl Chem., volume 16, pages 109 to 116.*

MEASURING EFFECT OF HEAT ON COAL

An instrument is shown for measuring the expansion or contraction caused by heat on a sample of coal and thus establishing the value of the coal for coking and other purposes. One gram of powdered coal is placed in a transparent silica tube and this tube is fixed in an aluminum retort, which rests on a tripod and is heated by a Bunsen burner. The silica tube is shown at (3) and the sample of coal at (4). The flame of the Bunsen burner is regulated by means of a micrometer cock. Heating conditions are thus maintained constant. A steel stem, provided with a flat piston, is shown at (1) suspended by a cord which passes around two pulleys and which is attached to a counter-weight at the



other end. The stem is guided in a steel cylinder (2). The vertical displacements in the silica tube are transferred to the needle of a registering instrument. An electrical vibrating instrument is shown at (7) which aids in overcoming the resistance due to the inertia of the movable parts of the apparatus. The thermometer is shown at (5) and the revolving drum at (6). When the instrument is used at atmospheric pressure, swelling of the coal sample commences suddenly at a temperature which is well defined for a given coal. On the other hand, the final point of swelling may vary. When the tests are made under pressure, the expansion of the coal is first preceded by a slight contraction. *—A. Shimomura; Fuel, volume 11, pages 340 to 343.*

ELEMENTS OF GAS TECHNOLOGY

Application of laws governing behavior of gas

ALL of the elementary gases, in their normal condition, have two atoms to the molecule, except argon and mercury vapor. Thus, hydrogen is properly expressed as H_2, Oxygen as O_2, nitrogen as N_2, and so on. There are, however, several forms of the elementary gases, containing more or less than the usual number of molecules. The commonest of these is ozone, which is a form of oxygen having three atoms to the molecule instead of two.

Atoms of one or more elements combine with those of different elements to form compounds, but the resulting compound may be entirely different in its nature from the elements which comprise it. Thus one atom of carbon, a solid, unites with four atoms of hydrogen, a gas, to form methane, CH_4, a gas. Two atoms of hydrogen unite with one of oxygen to form H_2O, water, a liquid. Similar examples could be continued almost indefinitely, and it will be found that each element combines with other elements always in the same exact proportions, by weight. This is known as the law of combining weights. Thus, sixteen parts of oxygen, by weight, invariably combine with twelve parts of carbon, by weight, to form CO, carbon monoxide. Similarly, thirty-two parts of oxygen combine with twelve parts of carbon to form CO_2, carbon dioxide or carbonic acid gas.

THE POUND MOL.—Having established the fact that each compound has a definite molecular weight, it is sometimes exceedingly convenient, in making gas calculations, to make use of a unit which is a physical weight having the same number of pounds as the molecular weight of the substance. This is called the pound-mol. In the metric system, the corresponding unit is the gram-mol.

AVOGADRO'S LAW.—In 1811, the Italian physicist Avogadro observed that equal volumes of different gases combine, at the same temperature and pressure, to form an equal volume of products, also at the same temperature and pressure. This led him to advance the hypothesis, since known as Avogadro's law, that equal volumes of different gases, measured at the same pressure and temperature, contain the same number of molecules.

Since the chemical formulas of gases also stand for mols of those gases, it is obvious that one mol of one gas would occupy the same volume as one mol of another gas. Experimentation has shown this to be true, within practical limits of accuracy. Theoretically, one mol occupies 378.4 cubic feet of space at 60° F. and 30″ Hg, regardless of what gas is being considered. Actually, however, gases differ slightly from the theoretical figure, as shown in table 2.

Table 2*

Volume of the Pound Mol of Ordinary Gases at 60° F. and 30″ Hg.

Gas	Cubic Feet per Mol
Hydrogen	378.3
Oxygen	378.2
Nitrogen	376.6
Carbon Monoxide	378.2
Carbon Dioxide	376.1
Methane	377.8
Water Vapor (theoretical)	378.6
Air	378.0

* *A.G.A., Chemistry of Combustion, Third Edition, 1932*

From the foregoing, it is evident that since equal volumes of gases contain the same number of molecules, under the same conditions of pressure and temperature, the number of reacting molecules can also represent the numbers of the reacting volumes, and this holds true whenever *all* of the reacting substances in a chemical equation are gases. That is to say, two molecular weights of hydrogen will always combine with one molecular weight of oxygen to form two molecular weights of water vapor, in accordance with the equation

$$2\,H_2 + O_2 = 2H_2O$$

Likewise, two volumes of hydrogen combine with one volume of oxygen to form two volumes of water vapor. The volumes can be expressed in cubic feet, cubic centimeters, or cubic miles, and the relation would still hold true, provided the same unit of measurement is used for each reacting gas. Liquids and solids, in their reactions with each other and with gases, must always be calculated from their molecular weights. It is obvious that it would be incorrect to say that two cubic feet of carbon combine with one cubic foot of oxygen to form two cubic feet of carbon monoxide in accordance with the equation

$$2C + O_2 = 2CO.$$

It is correct, however, to say that twenty-four *pounds* of carbon combine with thirty-two pounds of oxygen to form fifty-six pounds of carbon monoxide, as these are the proportions expressed by the molecular weights.

$$(2 \times 12) + 32 = 2 \times (12 + 16)$$
$$24 + 32 = 56.$$

In writing chemical equations to express the reactions between different substances and the amount of the products obtained by these reactions, the equation must be balanced so that the total number of atoms of each reacting substance will be the same on each side.

LAWS OF PERFECT GASES.—Perfect gases, or ideal gases, follow certain general laws when undergoing physical changes. Ordinary gases follow these same laws subject to certain modifications, as there is no such thing as a perfect gas or one which remains a gas under all conditions of pressure and temperature.

The most important of the laws governing the behavior of gases are known as Charles' law, Boyle's or Mariotte's law, Dalton's law, Pascal's law, and Avogadro's law, already stated.

CHARLES' LAW.—This law deals with constant volume and constant pressure changes, and states that if the pressure remains constant, the volume varies directly as the absolute temperature and conversely, if the volume remains constant, the absolute pressure varies directly as the absolute temperature. This law may be expressed where

$$\frac{V_2}{V_1} = \frac{T_2}{T_1} \qquad (1)$$

and

$$\frac{P_2}{P_1} = \frac{T_2}{T_1} \qquad (2)$$

V_1 = initial volume;
V_2 = final volume;
T_1 = initial temperature, absolute;
T_2 = final temperature, absolute;
P_1 = initial pressure, absolute;
P_2 = final pressure, absolute.

As examples illustrating this law, consider one cubic foot of gas at a temperature of 60° F. To what temperature must this gas be heated so that its volume will be doubled, without changing the pressure?

Applying equation (1),

$T_1 = 60° + 460 = 520°$ absolute
$V_1 = 1$ cubic foot
$V_2 = 2$ cubic feet

Then

$$\frac{T_2}{T_1} = \frac{V_2}{V_1} \text{ or } T_2 = \frac{T_1 V_2}{V_1}$$

$$T_2 = \frac{520 \times 2}{1} = 1040° \text{ abs.}$$

$1040 - 460 = 580°$ F., final temperature.

Consider this same gas at a pressure of 20 pounds per square inch, gauge, and a temperature of 60° F. What will the pressure become if its temperature is raised to 300° F., without change in the volume, atmospheric pressure being 14.4 pounds per square inch?

Applying equation (2),

$P_1 = 20$ pounds per square inch, gauge;
$T_1 = 60° + 460° = 520°$ absolute;
$T_2 = 300° + 460° = 760°$ absolute;

Then

$$\frac{P_2}{P_1} = \frac{T_2}{T_1} \text{ or } P_2 = \frac{P_1 T_2}{T_1}$$

$$P_2 = \frac{(20 + 14.4) \times 760}{520} = 50.28 \text{ pounds per sq. in. abs.;}$$

$50.28 - 14.4 = 35.88$ pounds per sq. in., gauge.

BOYLE'S OR MARIOTTE'S LAW—Boyle's law, as it is more commonly known, states that when a gas expands or is compressed at constant temperature, the volume varies inversely as the absolute pressure. Writing this algebraically, with the symbols used in the preceding paragraph,

$$\frac{P_1}{P_2} = \frac{V_2}{V_1} \text{ or } P_1V_1 = P_2V_2 = P_nV_n \qquad (3)$$

That is, the product of pressure times volume is a constant or $PV = K$.

For example, a gas at a pressure of 50 pounds per square inch gauge expands from 5 cubic feet to 15 cubic feet, without change of temperature. What is the resulting pressure, considering atmospheric pressure = 14.4 pounds per square inch?

By equation (3)

$$5 \times 64.4 = 15 \times P_2 \text{ or } P_2 = \frac{5 \times 64.4}{15.}$$

$P_2 = 21.47$ lbs. per sq. in., abs.
$P_2 = 7.07$ lbs. per sq. in., gauge.

THE EQUATION OF A PERFECT GAS — By combining Charles' law with Boyle's law, any condition of pressure, volume and temperature may be expressed.

Assume a unit weight of gas, say one pound, to be at a pressure P_1, with volume V_1 and temperature T_1. If this gas be permitted to expand, without change of temperature to some volume V_x, according to Boyle's law, it will be at a new pressure P_2 and temperature T_1, and the following equation will be true:

$$P_1V_1 = P_2V_x \qquad (4)$$

After reaching this stage, assume that the temperature changes to a new temperature T_2, keeping P_2 constant, in accordance with Charles' law. At the end of this stage it will be at pressure P_2, temperature T_2 and volume V_2 and between the second and third stages the relation will follow the equation

$$\frac{V_x}{V_2} = \frac{T_1}{T_2} \qquad (5)$$

From equation (4),

$$V_x = \frac{P_1V_1}{P_2}$$

Substituting this value of V_x in equation (5), we have

$$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2} \text{ or}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} = \frac{P_nV_n}{T_n}$$

that is, the value

$$\frac{PV}{T} = \text{a constant} \qquad (6)$$

The above constant in equation (6) is known as the Gas Constant. It is based on the unit weight at 32° F. (or 0°C) and standard atmospheric pressure at sea-level. To obtain the numerical value of the gas constant for any gas, substitute the specific volume, the standard atmospheric pressure at mean sea-level, and the absolute temperature in equation (4).

Taking air as an example, one pound of dry air under the above conditions occupies 12.39 cubic feet, at a pressure of 14.696 pounds per square inch and an absolute temperature of 459.64 + 32 or 491.64°.

$$\frac{14.696 \times 144 \times 12.39}{491.64} = 53.3$$

The gas constant for air, therefore, is 53.3, and the gas constant for any other gas may be found in a similar manner.

Equation (6) may be written

$$PV = MRT \text{ or } pV = MRT \qquad (7)$$

where

$P = 144\ p$ = absolute pressure, pounds per square foot,
V = Volume, cubic feet;
M = weight of gas, pounds;
R = Gas Constant
T = Absolute temperature, degrees F.

Equation (7) is known as THE FUNDAMENTAL EQUATION OF A PERFECT GAS, and expresses the relations of its pressure, volume and temperature.

THE GAS CONSTANT—The gas constant R can be

expressed in a number of different forms, depending on the units used. For horsepower calculations it is customary to consider M unit weight of gas as one pound; V the volume in cubic feet occupied by one pound of gas at a temperature T of 32° F. or 492° absolute, and a pressure of one atmosphere or 14.7# absolute.

For combustion calculations, it is usually more convenient to use the pound-mol as the unit of weight. Again taking air as an example, we have, as the volume of one pound-mol

$$V\ (1\ \text{mol}) = \frac{53.3 \times 491.64 \times 28.996}{14.696 \times 144} = 359\ \text{cu. ft.}$$

Substituting this value, which is the same for any gas, in the fundamental equation we have, using all units as above

$$R = \frac{14.696 \times 359}{1 \times 491.64} = 10.72$$

Similarly, if P is expressed in inches of mercury instead of pounds per square inch R becomes 21.85. In the metric system $R = 62.37$. Table 3 gives these values of R for various units.

Table 3

Values of Gas Constant R for Various Units

T Degrees F., abs.	Degrees F., abs.	Degrees C., abs.
P lbs. per sq. in.	Inches of Hg.	mm. of Hg.
V cubic feet	cubic feet	liters
N pound-mol	pound-mol	gram-mol
R 10.72	21.85	62.37

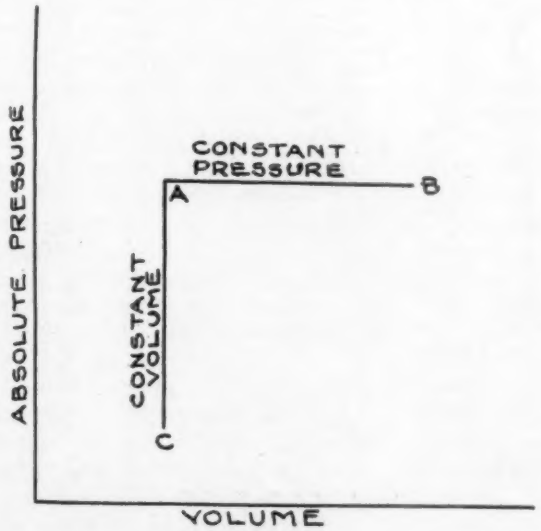


FIG. 1.— P-V Diagram illustrating Charles' Law.

The gas constant R represents the external work done when a gas changes both its temperature and its pressure. If a unit weight of any gas in a confined space is heated one degree, without any change in volume, no external work will be performed and the energy added will appear as an increase in the internal energy. The amount of this increase is equal to the specific heat at constant volume. If now the gas be permitted to expand against atmospheric pressure, thus doing work, the energy expended is equal to the specific heat at constant pressure. The difference between these two amounts of energy is the gas constant R.

$$\frac{PV}{T} = C_p - C_v = R \qquad (8)$$

where

C_p = Specific heat at constant pressure;

C_v = Specific heat at constant volume.

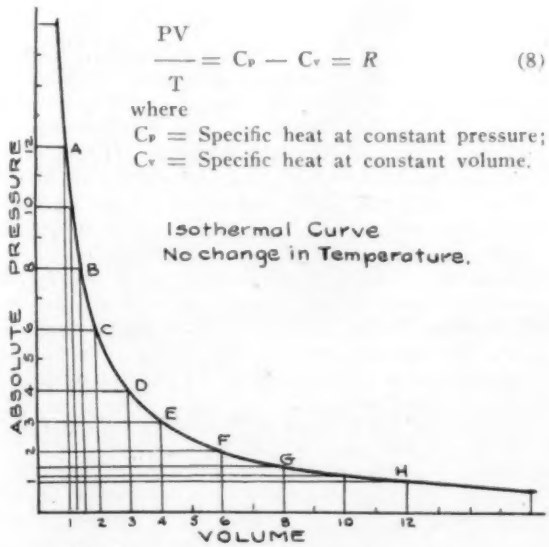


FIG. 2.— P-V Diagram illustrating Boyle's Law - PV = Constant.

Expressed in B.t.u. per mol of perfect gas, $R = 1.985$ B.t.u. per mol per degree Fahrenheit, but since most gases deviate somewhat from the laws governing perfect gases, the value of R for average ordinary gases is taken as equal to 1.987 B.t.u. per mol per degree F. The value 1.985 above is obtained simply from the fundamental equation as follows:

$$R = \frac{\text{Vol. of 1 mol} \times \text{1 atmosphere}}{\text{Std. Temp. F. abs.,} \times 778} = 1.985$$

P-V DIAGRAMS—The P-V diagram, Fig. 1, illustrating Charles' law, shows that either the pressure or the volume is represented by a horizontal or a vertical straight line, depending on which factor remains constant. In both cases, there has been a change in heat content, and the amount of this change is dependent on the weight of gas used, the temperature change, and the specific heat of the gas.

In Fig. 2, illustrating Boyle's law, the P-V diagram becomes an equilateral hyperbola. For any given change, no heat is added or taken away. When the change takes place from a higher pressure to a lower one, as in expansion, the gas is doing work; conversely, when the change is in the opposite direction, as in compression, work is being done on the gas. As no work can be done except at the expense of some form of energy, if the temperature remains constant it follows that heat must be added to or subtracted from the gas during the change in condition, and this amount of heat is a measure of the work done. Such operations are known as isothermal heat changes, and follow curves which satisfy the equation, PV = a constant.

When the temperature varies, as well as the pressure and volume, the compression or expansion becomes adiabatic, and follows a curve whose equation is PV^n = a constant. The term adiabatic means that all the work is done at the expense of energy within the gas itself, no heat being added or taken away. The exponent "n" is equal to the ratio of the specific heat at constant

pressure to the specific heat at constant volume. Expressed mathematically,

$$n = \frac{C_p}{C_v}$$

In computing all thermodynamic problems relating to gases, it has been customary to use an atmospheric pressure of 760 mm or 29.92″ Hg, and a temperature of 0°C or 32° F. However, it has been found more convenient, in American manufactured gas practice to set up a standard of 30″ Hg and a temperature of 60° F., with all commercial gases assumed to be saturated with water vapor except air, which is assumed to be at 40% relative humidity at 60° F. In natural gas practice, a different set of values is taken as standard, namely 14.4 pounds per square inch absolute atmospheric pressure, base pressure 4 ounces above 14.4 or 14.65 pounds per square inch absolute, and base temperature 60° F., with all natural gas assumed to be dry at these conditions of temperature and pressure.

DALTON'S LAW—Dalton's law states that the total pressure exerted by a mixture of different gases is equal to the sum of the pressures which each constituent gas would exert if it were to occupy the same volume as the total volume of the mixture.

Dalton's law is not only applicable to ideal gases, but is equally true with respect to mixtures of gases and vapors. If a gas mixture is composed of 80 per cent methane, 15 per cent nitrogen and 5 per cent carbon dioxide, and the mixture is at a pressure of 50 pounds, the methane will exert .80 × 50 or 40 pounds pressure; the nitrogen will exert .15 × 50 or 7.5 pounds, and the carbon dioxide will exert .05 × 50 or 2.5 pounds.

PASCAL'S LAW—Pascal's law states that an external pressure applied to a fluid is transmitted equally in all directions, and acts with the same force upon all surfaces in a direction at right angles to those surfaces. This means that the pressure applied to any area of a confined fluid is transmitted, without loss, to every other equal area through all of the fluid to the walls of the containing area. The law of course covers all fluids, liquid as well as gaseous.

TABLE OF CHEMICAL ELEMENTS

Atomic Weights Based on O = 16

Element	Symbol	Atomic Weight	Element	Symbol	Atomic Weight	Element	Symbol	Atomic Weight
Aluminum	Al	27.1	Holmium (5)	Ho	163.5	Rhodium	Rh	102.9
Antimony	Sb	120.2	Hydrogen (4)	H	1.008	Rubinium	Rb	85.45
Argon (1)	A	39.88	Indium	In	114.8	Ruthenium	Ru	101.7
Arsenic (2)	As	74.96	Iodine (2)	I	126.92	Samarium	Sa	150.4
Barium	Ba	137.37	Iridium	Ir	193.1	Scandium	Sc	44.1
Bismuth	Bi	208.0	Iron	Fe	55.84	Selenium (2)	Se	79.2
Boron (2)	B	10.9	Krypton (1)	Kr	82.92	Silicon (2)	Si	28.3
Bromine (3)	Br	79.92	Lanthanum	La	139.0	Silver	Ag	107.88
Cadmium	Cd	112.4	Lead	Pb	207.20	Sodium	Na	23.00
Caesium	Cs	132.81	Lithium	Ll	6.94	Strontium	Sr	87.63
Calcium	Ca	40.07	Lutecium	Lu	174.0	Sulphur (2)	S	32.06
Carbon (2)	C	12.0	Magnesium	Mg	24.32	Tantalum	Ta	181.5
Cerium	Ce	140.25	Manganese	Mn	54.93	Tellurium (2)	Te	127.5
Chlorine (4)	Cl	35.46	Mercury (7)	Hg	200.6	Terbium	Tb	159.2
Chromium	Cr	52.0	Molybdenum	Mo	96.0	Thallium	Tl	204.0
Cobalt	Co	58.97	Neodymium	Nd	144.3	Thorium	Th	232.15
Columbium (Niobium)	Cb	93.1	Neon (1)	Ne	20.2	Thulium	Tm	168.5
Copper	Cu	63.57	Nickel	Ni	58.68	Tin	Sn	118.7
Dysprosium	Dy	162.5	Niton (6)	Nt	222.4	Titanium	Ti	48.1
Erbium	Er	167.7	Nitrogen (4)	N	14.01	Tungsten	W	184.0
Europium	Eu	152.0	Osmium	Os	190.9	Uranium	U	238.2
Fluorine (4)	F	19.0	Oxygen (4)	O	16.00	Vanadium	V	51.0
Gadolinium	Gd	157.3	Palladium	Pd	106.7	Xenon (1)	Xe	130.2
Gallium	Ga	70.1	Phosphorus (2)	P	31.04	Ytterbium	Yb	173.5
Germanium	Ge	72.5	Platinum	Pt	195.2	Yttrium	Yt	89.33
Glucinum (Beryllium)	Gl	9.1	Potassium	K	39.10	Zinc	Zn	65.37
Gold	Au	197.2	Praseodymium	Pr	140.9	Zirconium	Zr	90.6
Helium (1)	He	4.00	Radium	Ra	226.0			

Notes:

Above table shows 83 elements out of a total of 92 now known.
All the elements are metals except as noted.
(1) Inert Gas. (2) Metalloid. (3) Liquid. (4) Active Gas. (5) Not Placed. (6) Radium Emanation.
(7) Liquid Metal.

Effective Advertising Appeals

Analyzed by the Copywriter

SOLID COMFORT

YOU can talk about beauty, leisure, cleanliness, health and other attributes ad infinitum; but the truth must be told, namely that, if human beings had not greatly desired comfort, it is very doubtful whether there would be any great utility industries in existence in the present day. Other faculties were stimulated, if not created, by the development of utility service. Comfort, on the other hand, lies close to the original source.

When in doubt, therefore, comfort is a dependable stand-by; the advertiser can ring as many changes on this theme as the limitless variety of human nature permits.

We begin, quite naturally, with warmth, the primal desire that comes even before hunger. Consider it from the outside looking in—the shivering passerby glimpsing a warmly lighted room through the window glass. Here is a familiar picture, and a familiar experience. It starts us readily on a long chain of headlines of which the following are only a few:

"New Comforts for Cool Autumn Days"; "Comfort! Whatever Weather Comes"; "Oh, for the Comfort of a Radiant Gas Heater"; "Open-Fire Comfort Returns!" "The Comfort of an Open Fire Place"; "Quick Comfort"; "Warm Up . . . for Comfort"; "The Clean, Colorful Comfort of a Gas Fireplace."

Over and over, the same word grows monotonous when all its variations are grouped together as in the preceding paragraph. The Copy Writer, in desperation seizes gratefully on the word "cozy", which expresses all that and something more besides. "Clean, Colorful, *Cozy* Heat from a Glowing Grate" goes our last headline considerably better and conjures up a picture that establishes ready acceptance for the service which it sells. Another advertisement stresses that "Gas Heat is Always Ready . . . A *Cozy* Circle for Cold Mornings." It is a word with overtones.

Comfort reached its ultimate as big business with the achievement of the modern American hotel with a bath, radio and telephone in every room. A curious aspect of this development appears in the way our people generally demand these super-comforts when they travel, while their homes continue to be lacking, many times, in even the ordinary conveniences. A personal acquaintance confessed to us recently that he looked forward to his business trips for one reason alone: he was sure of having plenty of hot water all the time! One can only imagine the antiquated system that was doing what he probably called "duty" in his home.

Luxury Concept

The modern hotel brings together in one concept the idea of luxury and the minimum of decency. Such a symbol which is readily recognized should be, and will be, capitalized by the astute advertiser. Suggested caption—"At Least You Should Have Hotel Comforts." What an opportunity there is here to point out that " a single night's hotel bill would more than pay for an unfailing hot water supply in your home for a month!" "Has *Your* Home the Comforts of a City Hotel?"

Comfort, as we know if we stop to realize, consists of not only the immediate benisons that gratify our senses but also the absence of distractions—especially when we are looking for relaxation or rest. One of the distinguishing features of present-day gas appliances is their welcome noiselessness. This theme, we remember, was the basis of the successful campaign that introduced the revolutionary gas refrigerator. As applied to the comfort appeal, we have—"Quiet . . . for the Benefit of Those Who Have Retired"; "The Zone of Quiet" and similar variations.

For the best use of comfort psychology, however, we must return to the heating system. From the "zone of quiet" we have the "comfort zone." "Jump from Bed to the Comfort Zone!" "Keep Your Rooms Zoned to Comfort"; "Let Gas Maintain the Comfort Zone"; "Widen the Comfort Zone in your Home". A tricky phrase, perhaps, but it gets over in a few words all the advantages of comfortable, uniform heat. A "zone" suggests immediately the upper and lower limits of fluctuation characteristic of automatic gas heat.

Besides, what is the most luxuriously comfortable moment of your day? If you are anything like the average person, you will admit that it is the few extra minutes in bed between waking and rising. Songs have been written about it! We dare say that more gas heating systems have been sold on the strength of this appeal than even the well known "shadow of the shovel."

A half hour additional sleep in the morning is certainly a tangible inducement which can be estimated (by the prospect) in dollars and cents. There is also the important consideration that, when he *does* get up, he is certain to find the heating plant functioning properly at the de-

sired temperature. "Be Sure of a Warm House in the Morning" is a message that awakes many contrary recollections in the average mind. "Wake Up in a Cozy Home!"

The idea of sleeping while the gas company tends the furnace is of the same piece with the "armchair fireman" conception of comfort. As for example, "Eat Breakfast in Comfort . . . Let *Us* Bring Up the Fire." "What a Relief! Nothing To Do But Relax and Be Comfortable." Here the modern gas range comes in for its share of attention with a "Photograph of a Woman Cooking Dinner for Six"—namely, mother in her easy chair. "Now Mother Rests While Dinner Cooks"; and "Your Gas Range Works While You Rest" are two appealing thoughts.

Comfort—Result of Foresight

Comfort, as even prehistoric man discovered, is largely the result of foresight. "Stop Heating Discomfort" is all very well to advertise in the midst of winter when it is difficult to do very much about it. "Live in Comfort This Winter" is closer to it when timed for fall. Spring demonstrates the fact that "Comfortable Heating Is Most Difficult in February, March and April." But the best advertising can be done right in the summertime with such reminders as "Think Now of Next Winter's Comfort" or "Plan Now To Be Lazy Next Winter (Do You Like To Loaf?)" There is no fixed season for the sale of gas heating. It means "Real Comfort the Year Round" making the house actually "More Comfortable in Winter Than in Summer."

Besides the real *living* comfort provided by modern gas service, it is a relief to know that things are going as they should while you're out of the house. That means "Comfort Without Worry in Heating Your Home with Gas." Look forward to coming "Home to Comfort" and then discover that the house is "Just as Cozy as When You Left!" Even in the summertime, when you spend a large part of your days lolling in a hammock or on the beach, the thought may come with double force: "If She Could Only Find Such Comfort in the House!" Then ask yourself, "Have You a *Restful* Home?" "The Man Who Loves His Family Provides for Their Comfort." Perhaps we should re-word the marriage ceremony "To Love, Honor, and Keep Her in Comfort"—if it isn't too much trouble.

It is the permanent assurance of comfort that makes automatic gas service attractive, however it may be used. It "Ends Furnace Worries;" provides "Solid Comfort Since the Frst Cold Day." This thought may be summed up as "Comfort Insurance with Gas Heat." Here we are close to the economy of comfort—an always-recurring theme.

The two things inevitably go together, reminding us of the "Comforts You Miss Yet Pay for . . . by Heating with Coal"—or any other fuel. It is a matter of receiving "Your Money's Worth in Comfort when You Heat with Gas." There is a large offsetting item of economy, whatever the rate, in the demonstrable fact that "In Terms of Comfort Received . . . It Costs Less to Heat a House with Gas." What could be more timely, therefore, than this message: "You Can't Hoard Comfort in a Teapot?" Everyone loses when you wait! Carry this one step farther and advise "Dividends in Comfort," reminding your customers that modern gas appliances have been designed to facilitate the homemaker's work—to pay large dividends in comfort and convenience.

It has been truly said, "There is No Saturation Point for Comfort." Heat—"Harnessed for Comfort"—is one of the shortest cuts to successful selling of "GAS—THE COMFORT FUEL."

KEEP YOUR ROOMS "ZONED TO COMFORT"
WITHOUT WORRY OR WORK....
Install MODERN-CLEAN-EFFICIENT
GAS
HEATING EQUIPMENT
How many temperature zones have you in your home? Are there chilly halls, closed-off rooms while even your "warm rooms" often drop below the zone of comfort when the fire is neglected?
Today there is no need for parts of the house being cold and only favored rooms kept warm. Today there is no need of bothersome fire tending, stoking, or poking. Modern gas heating equipment has put an end to all this. Such equipment, because it is easily controlled, assures even "Comfort Zone" warmth to every room, regardless of the outside weather. Clean quick-acting heat flows from gas heating equipment at a finger's touch on electric button, key, or automatic thermostat.
You can modernize your home with gas heating equipment to have Controlled Gas Heat for a very small down payment and you can spread the cost over many months. Ask this company for particulars, or consult your local heating dealer.
Natural Gas will maintain this Comfort Zone 65° 71° at low cost
SEE YOUR DEALER OR THE
P · G · and E ·
PACIFIC GAS AND ELECTRIC COMPANY
Owned · Operated · Managed by Californians

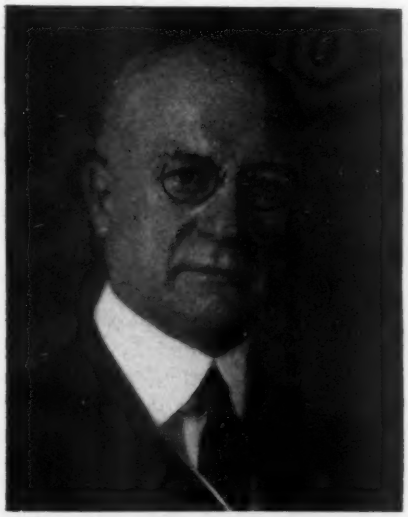
ALERT sales-people soon learn that when the home manager shops she shops for ideas for better and more efficient cooking and a brighter, more modern and carefree kitchen. Remember this when showing your wares and you will also sell her VALUE.

CONSISTENT direct mail advertising will get results these days when sent to a carefully picked list of prospects and carefully followed-up by the personal call of a salesman. If you do not care to pick your list and use care to see that it is followed-up on a predetermined schedule, save your money.

WHEN you advertise amusements or other activities in your display windows you are suggesting to folks that there are other ways to spend their money aside from purchasing the merchandise you have for sale.

EMPLOYEE LOYALTY - - *The Measure of an Industry's Greatness*

Short narratives of how the old-timers met and overcame emergencies



Howard G. Bishop

A Race Against Disaster

Mr. Howard G. Bishop is rounding out his 45th year with the Consolidated Gas Electric Light and Power Company of Baltimore.

Mr. Bishop began his work as a photometrician in the days when candle power was the gas standard and his experience has embraced a wide range of laboratory analysis, supervision in the manufacture of gas, accounting and valuation work.

In his long experience Mr. Bishop recalls two contrasting emergencies, one resulting from the great blizzard of 1897 when he did not have his clothes off for three days or nights as a result of the heavy snow which interfered with the handling of coal and the operation of holders, and the other the Baltimore Fire of 1904. During this conflagration which lasted three days and destroyed the principal business section of the city, the Baltimore Company met the emergency of maintaining a supply of gas, notwithstanding the huge loss resulting from the escape of gas within the fire zone.

Referring to the fire Mr. Bishop said:

"Through use of the Company's reserve capacity in holder and generator facilities an adequate supply of gas was maintained during the fire. Hundreds of buildings were destroyed and it was necessary to overcome the loss occasioned by the amount of gas that escaped from the broken pipes serving these buildings. This was accomplished while the work of stopping the flow of gas in the burned area was being carried on.

"As a result of the use of dynamite to destroy buildings during the fire a number of our gas mains were cracked and water seeped into them. After it was possible to repair the mains and free them from the water, it was necessary to notify the gas consumers in those districts to examine their fixtures and close all stop cocks before gas could again be sent through these mains.

"In addition to its accomplishment in maintaining a supply of gas the Company, despite the burning of its offices, saved its records, mobilizing its meter wagons and men not engaged at the plants or in the Distribution Department in the work of transferring them to an ultimate place of safety."

To the Rescue—In a Nightshirt!

When an over-taxed gas line gives way, it is a serious proposition, particularly when a city's inhabitants are depending upon that line for their fuel supply.

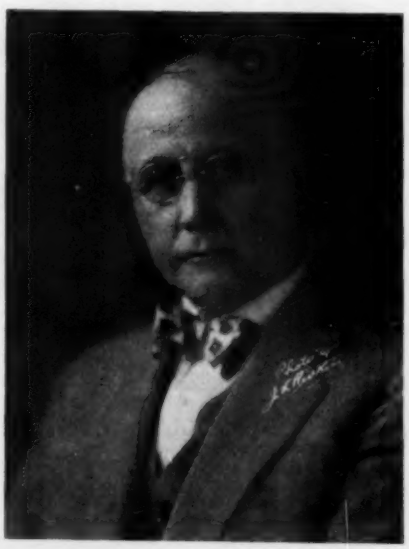
But when the distributing company is prepared to turn gas from another line into the mains, the situation is clarified.

And when humor is added to the affair—well, it's just something to look back upon in later years with many hearty laughs.

That's the way William H. Bagley of the Oklahoma Natural Gas Corporation feels when he recounts the many early day experiences in serving Oklahomans with natural gas. Bagley, who is one of four men with more than twenty-five years service with the Oklahoma Natural, is now public relations representative for the Tulsa District and looks back upon his company affiliation as the most pleasant of his fifty-seven years of living.

He came to Indian Territory and Tulsa in 1905 as agent for the Osage and Oklahoma Natural Gas Company, which was the childhood name for the now mature Oklahoma Natural Gas Corporation. Since then he has been in a managerial capacity in the Tulsa city office and Tulsa district until 18 months ago, when he was relieved of office duties to devote more time to the many civic projects with which he had identified himself.

Bagley can recount dozens of



Wm. H. Bagley

thrilling experiences in the early days of serving gas in Oklahoma, but being of a humorous mind he chose recently to tell the following incident:

"I remember a night in 1909," he began, "when Tulsa was being supplied from a six-inch line coming from the Osage Nation (located on the western outskirts of the city). This line was carrying, on the night in question, a pressure of 400 pounds. About 1:30 a.m. the line let go with a terrific roar that drove all the residents out of their homes 'en dishabille' with no thought other than there must have been an earthquake.

"This left the city for the moment without gas other than that in the medium pressure lines of the distribution system.

"However, there was another feed line coming into the city from the east, but this line was completely shut off and the high pressure regulator station was located several miles from downtown Tulsa. A field man, Davy Norris, lived nearby, though, and I got on the telephone, yelling nearly loud enough to be heard without a phone, 'for God's sake, Davy, get some gas in quick! The Osage six-inch line has just let go'."

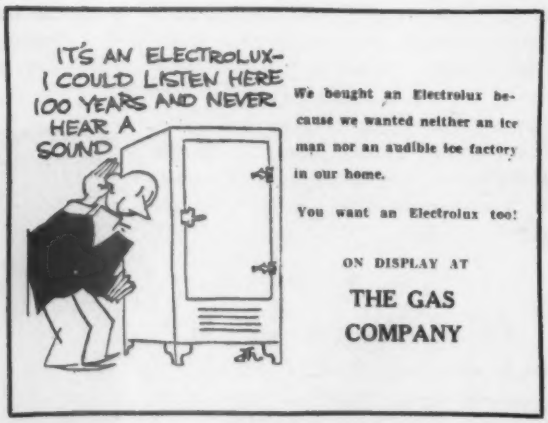
Bagley then says that Norris tore out of the house on the run, clad in only a nightshirt, reaching the regulator house in time to turn on the gas just as the medium pressure had dropped to two pounds.

To which Bagley only added the comment that "clothes may make the man, but why bother in an emergency."

Bagley also pointed out a feature in connection with this incident, of particular interest to gas men, in that there was an auxiliary line supplementing the six-inch. This line consisted of some old second hand thirteen-pound four and seven-eighths casing, fourteen thread and short collars. This line had the same four hundred pound pressure and held, whereas the new six-inch of considerably greater weight let go, Bagley said.

Ice Cards Good Tip for Iceless Prospects

By
O. B. SERVER


IT'S AN ELECTROLUX—
I COULD LISTEN HERE
100 YEARS AND NEVER
HEAR A
SOUND
We bought an Electrolux because we wanted neither an ice man nor an audible ice factory in our home.
You want an Electrolux too!
ON DISPLAY AT
THE GAS COMPANY

"ONE of the most effective plans we have found for securing prospects for iceless refrigerators," says the gas company in Lexington, Kentucky, "is through keeping our eyes open for the ice cards displayed in the windows of homes in the good residential districts of the city. We figure that practically all of these are in the market for modern home equipment, and will buy a gas refrigerator if we can convince them of the convenience and comfort of same.

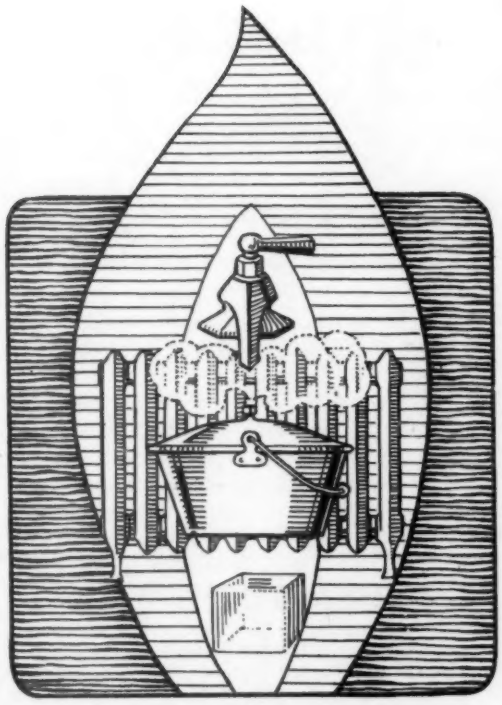
"We have outside men who are constantly on the lookout for prospects, and once one is secured it is followed up until a refrigerator is placed in the home or our man learns he has purchased elsewhere.

"The sale of gas refrigerators has progressed nicely, and we have enjoyed a comparatively satisfactory turnover on our stock. Window display is the most effective method of publicity, and newspaper ads, if they are snappy, are a good second. Last spring we made a decided play for the refrigerator business, with excellent results considering the business depression. We arranged a window, showing one of our finest refrigerators, the door of which mechanically opened and closed, permitting the spectator to have a view of the inside. One of the great features we have claimed for this refrigerator is the silence in which it operates, and this we brought out in the display by having a life sized figure of a man placed near the front of the refrigerator, bent forward in an attitude of listening. A card over his head said "I could listen here a hundred years and never hear a sound." Another card advised the terms on which the article was sold, while several gay-hued lithographs supplied by the manufacturers added color to the picture and called attention to several of its good points.

Daily Ads Used

"We backed up this display with a series of daily ads, each of which was different, but all of which drove home the silent efficiency of our product. All of them had a drawing of a man listening at the door, as shown in the accompanying typical example.

"Direct mail is also good in creating interest in new models. A series of three illustrated circulars are mailed each month to a selected list of prospects, the mailing being about two weeks apart. As soon as any interest is manifested, either by an inquiry or a call at the display rooms the prospect is at once turned over to one of our special men. A call is usually made at an hour when both the master and the mistress of the house are apt to be at home, and an effort is made to set a special date when the salesroom will be visited and an opportunity given to demonstrate all the good qualities of the refrigerator. Knowledge of our line, and gentle persistence without becoming a pest, are the greatest factors in creating sales once the attention of the prospect has been gained."



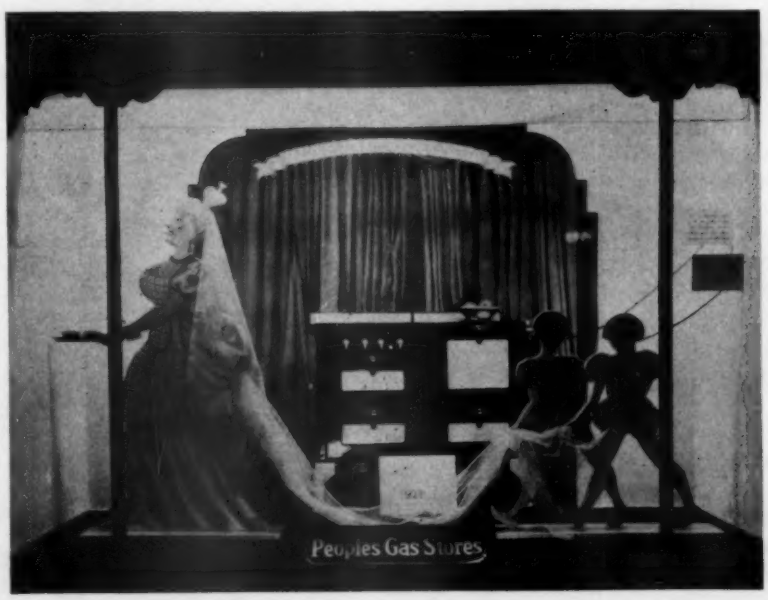
PROFITABLE POINTERS

SOME dealers in research say that most persons can pass the average gas appliance dealer's window in seven steps. That sounds reasonable; yet, during the past few months, we have seen a number of window display advertisements in the stores of gas companies which just would not let us pass them without stopping, and stopping many others.

MERCHANDISERS are agreed that there is no valid reason for a "set" arrangement of appliances. The arrangements of store stocks should be changed as often and as carefully as window displays. A frequent re-arrangement of ranges and even the smaller appliances has a tendency to speed-up sales. One man who made a study of re-arrangements found that there obtained weekly increases as high as 10% on certain items.

A GROWING business needs advertising as much as a growing plant needs rain. Gas men should exert every effort to advertise the comfort, convenience, cleanliness and controllability of gas for cookery.

"WHENEVER I find a fussy, hard-to-please customer, boy, oh boy!, I get busy trying to please him," said an acquaintance the other day, and added, "for once I please him he is one of the best advertisers I can possibly have, and, all in all, he's a good spender, too." Ponder this over and do your best to please buyers of this type.



SIMPLICITY and effectiveness are both attained by the gas range window of the Peoples Gas Store, Chicago. In this particular display the Queen of Hearts has just successfully baked some tarts on a modern gas range for his nibs, the King of Hearts.

IF store sales are not up to par make sure that your sales people know all there is to know in regard to the merchandise; also, that they courteously and efficiently meet and greet and serve those who enter your store. It has been said that the salesman who is inadequately informed regarding the merchandise that the is trying to sell is responsible for forty per cent of the sales lost, while indifference to customers runs a very close second.

MANY men have many ideas regarding window display advertising. Putting human interest into your displays helps sell merchandise, as do seasonable settings. "Make your window display advertising reflect the character of your store" is sound advice given by one man who is securing enviable results from his display ideas.

EXPERT merchandisers have discovered that America is a right-handed nation. Display men who wish to cash-in on this fact will do well to build with great care the displays in the window to the right of the entrance to their stores. This does not mean that the window to the left of the entrance should be planned without thought, but rather that if either of the two displays is built for the purpose of making sales of an un-advertised item, a store special, or for the purpose of introducing a new appliance or as a tie-in to an item advertised, the window to the right will probably secure better results.

CONDUCT store demonstrations on "The economy of gas cookery;" plan

to have at least one such demonstration each week.

IF your advertising budget has been pared and you are having to watch your newspaper schedules, why not give a thought to window display advertising? Manufacturers are offering some very attractive helps and too, surely there is someone in your organization who can build some very effective displays if but given the opportunity. Why not find that person and turn over to him or her your file of the *American Gas Journal* where will be found an abundance of ideas that have been supplied from time to time by the leading display men of the industry.

THIS water heater business has us coming and going. Here we find one company holding off, here one going on and there one pushing the

sale of the tank or circulating type gas water heater. This is the season to sell hot water service and we would say that the company that does not make an effort to sell one type or the other is bidding fair to have some other fuel come in and capture this load.

SALESMEN who consistently canvass from house to house are bound to secure enough business everyday to afford them a good living, and they will accumulate enough live prospects to make some real money very soon. Confidence is returning and jobs will soon be more plentiful. This means that there will be pay-day and ready money to buy merchandise. Keep plugging and you are bound to profit therefrom.

SO CALLED "over the back fence advertising" is very profitable —IF you have a satisfied customer who is doing that advertising. Perhaps this truth gave rise to the slo-

gan used by a renowned merchant who said "the customer is always right."

WE like the way the Magic Chef folks brought out the twelve features for the use of salesmen—few words,

12 *EXCLUSIVE* MAGIC CHEF SERVICE FEATURES . . . .

Only a Magic Chef has them all

1. **Magic Chef (500 Series) Design and Finish** Modern and stylish. Compact only 40" wide. Kept clean easily.
2. **Cooking Top Cover** Folding cover, spring balanced.
3. **Three-in-one Non-clog Top Burners** Simmering, an ordinary, or a fast fire. Removable, non-corrosive heads. Spill-overs won't clog.
4. **High Sanitary Burner Tray** Conceals the burners, protects them from spattering grease.
5. **Automatic Top Burner Lighter** Lights any top burner the moment valve is opened.
6. **Lorain (Red Wheel) Oven Heat Regulator** The original. Thoroughly dependable.
7. **Smooth Sanitary Oven Linings** No projections. Easily cleaned.
8. **Insulated Ovens** Keep kitchen cooler. Save gas.
9. **Ample Cooking and Baking Capacity** Has ample capacity for a family of ten people.
10. **Reversible, Rackless Broiler Pan** Special design prevents fats catching fire.
11. **All Porcelain Enamel Finish** Enameled throughout, including linings.
12. **All Steel Construction** Built of unbreakable steel. Built to endure and serve.

(Carry this Vest-Pocket Reminder with you)

right to the point and in a form that the salesman may conveniently carry in his pocket for ready and quick reference.

IF you have a picked prospect list a consistent direct mail campaign should be employed to de-

velop it into customers. If you haven't, build one up at once and use it intelligently; follow-up the mailings by personal call and you can count the results. The average direct mail campaign is not followed out as planned or followed-up as promised and therefore it is often said "direct mail advertising is not productive."

WE know a fellow out west who has worked out an advertising schedule that provides for an advertisement each and every day in local newspapers (naturally the space is small). He contends that this is the time to keep everlastingly before the prospective purchaser and too he says, "a dollar spent for newspaper advertising today gives me two dollars value, for I get more readers and more reader interest. Fewer advertisements make this possible."

"SO sorry to keep you waiting, I will serve you in just a moment,"

often eases the ire that frequently arises when a customer has to wait a few moments to be served.

THAT S.G.E. gas range designed by Norman Bel Geddes is an innovation. At first it rather startled us—it came so quick and was such a departure—but now the more we look upon it the more we like it. Bet the display men will do things with it! Speaking of gas ranges, even with everyone holding back, we would say that the man who goes out to sell ranges today has a wonderful story to tell: new design, effective color combinations, new drip and broiler pans, wonderful burners and broilers, timing and heat regulating devices . . . sometimes wish we were pulling door-bells again.

THE home service department should be functioning to the limit right now. Never has there been a better time to interest the home manager in home economics than exists today.

men sit down with the husband and wife together and if the 'vice-president of the home' is favorable usually the 'president' will yield to persuasion.

"Plumbing and heating in connection with new construction is out of our thoughts at the moment. Competition is so keen that often the lowest bid is about one-half of the highest bid, a condition never before common. The lowest bidder usually loses on the contract unless he skins it as to material or workmanship or both. We do not believe in taking jobs just 'to keep our force busy.' We would rather devote the time to appliance selling and earn a profit on our efforts.

"Consider the plumber who works on new construction. It's often six months between the time when he installs the piping, or 'roughing in' and the date when the fixtures are installed and the bill collected. Our investment in labor and materials is likely to be tied up for many months. Then the builder or the owner may not be able to pay and we lose out altogether.

"Now that we specialize in gas appliances our profit is safe and in the safe as soon as we have completed the installation. Our assets are liquid all the time and enable us to expand our business, pay our force, pay our material bills and keep our business running along smoothly."

Despite the fact that Philip Maher Plumbing and Heating Co. avoids new construction work, except as it relates to appliance merchandising, the company continues to solicit and execute alteration contracts. It is considered that this permits the dealer's men to gain the confidence of their customers and thus helps sell appliances.

The plumber finds he can urge automatic control, safety valves on water heaters, recommend a new range and advise discarding the old ice box for the more modern appliances and do so most effectively when he is called to the home by the customer. He is there by invitation and this makes the selling duty easier than when it is a case of "cold" canvassing. these church women with their teas.

"In the lecture hall there is a stage fitted up with an efficient kitchen containing a gas range and modern equipment. We do not say 'model' kitchen as do many firms, as that scares the average man and woman who fear the cost of fitting up same will be prohibitive. In calling attention to our kitchen I merely stress the fact that the woman needs the best of modern equipment in her kitchen, just as her husband needs it in his factory or office, in order to accomplish the best results with least labor.

Free Cooking School

"In this room there is held a free cooking school one day each week during the winter season. It is so hot here that everybody goes away during the summer, so the school is discontinued then. But it opens again in September and continues until June. The school session lasts from two to four. The date of the week in which the cooking demonstration is to be held is announced several days in advance, and on the morning it is to occur our ad bears the complete menu to be prepared. This is always a well balanced meal, with appropriate menus for special occasions, such as Christmas or Easter. A sample menu includes: Fruit cocktail, roast chicken, buttered peas, duchess potatoes, cranberry mold salad and mince pie. Complete oven dinners are featured most frequently. As I prepare each dish I tell of the utensils best adapted to hold it, and when it is placed in the oven, I carefully explain how the heat can be regulated to cook any class of food—slowly, medium or quickly. Mimeographed copies of the menu, with the complete recipe for each item, have been prepared in advance, and these are handed out to those present at the conclusion of the demonstration. As the proof of the pudding is in the eating, the food prepared is passed around for inspection and sampling, so that all can see how delicious is food cooked in a heat controlled gas range.

"My office, if such it can be called, is merely a desk at one end of the lecture room, with several chairs, and I am here the greater part of the day, so that housewives can bring their cooking problems to me to be

(Continued on page 52)

Show The Housewife The Economy of Gas

By W. B. STODDARD

"IF you want people to buy gas equipment you must first convince them of its efficiency and economy," says the Home Economics Department of the Central Arizona Light and Power Co., Phoenix, Ariz. "You can't always be thinking of sales—you must first win the esteem and confidence of the housewives. This has always been the policy of our company, and with this thought in view our large basement lecture hall and demonstration room is always at the service of any religious, social or civic organization, free of charge, provided the proceeds of the luncheon or dinner are for charity or civic service and not for private gain."

On the afternoon of the interview a big tea was being given by the women's auxiliary of one of the churches, and the cooking operations were supervised by the Home Service Director. "On such occasions as this I never give any formal talks from the stage," she said. "Such proceeding would be looked upon as trade propaganda and would deter many organizations from asking for our room. But we offer them free gas, and the use of our ranges, as well as all the cooking equipment. You would scarcely believe it possible, but a number of women who are giving this dinner have never cooked on a gas range, and were glad of my assistance in showing them how to use it. Actions speak louder than words—they see for themselves the efficiency of gas, the controlled heat, and the coolness of the gas kitchen (a great item in this climate) and its cleanliness as compared with wood and coal. Many valuable contacts have been made through helping

Plumbing Contractor Soft Pedals Plumbing and GOES GAS

By R. C. NASON

THERE is marked significance for gas companies in the recent transition of the retail business of Philip Maher Plumbing and Heating Co., St. Albans, N. Y., from contracting to gas appliance merchandising. Like several other plumbing firms that operate under the dealer plan of the Brooklyn Union Gas Co., the Maher exhibition floor contains nothing but gas ranges, gas refrigerators, water heaters and gas boilers where formerly stood bath tubs, lavatories and kitchen sinks.

It is not understood that Philip Maher has deserted the plumbing and heating business altogether, for the company still does considerable alteration work. But, as the owner explained recently, "We find that alteration work helps us sell more gas appliances."

"Naturally," continued S. H. Hazelbauer, superintendent, "in 10 years of conducting a plumbing and heating business here we have accumulated a substantial clientele. It is to these customers that we turn now for orders for ranges, refrigerators, improved water heaters, gas heating and other appliance business."

Paying Bills at Plumbers

When the Brooklyn Union Gas Co. offered the Maher company an opportunity last spring to accept gas bill payments from local residents the transaction was concluded without delay. For, the dealer at once saw that this would bring large numbers of local people into his store where they could be sold appliances of many kinds. As the arrangement works out, more than 200 persons enter the establishment daily to pay their bills. To reach the cashier's window they must pass through a long aisle flanked on both sides by gas appliances.

On the display floor are 24 ranges, six water heaters and an equal number of gas refrigerators. Two employees of the dealer are always present to interview all persons who show interest in appliances. Their days are busy and sales frequent.

Every two months the dealer conducts a special selling drive on one or more of the three major classes of appliance. Advertising is made effective through the efforts of five outside salesmen employed on a commission basis. Instead of soliciting business at random, as some dealers do, Mr. Maher restricts his salesmen to definite territories and expects each man to adhere to the boundaries outlined.

Evening Meetings Help

A phase of the Brooklyn Union Gas Co. co-operative dealer plan which works out well in the case of this St. Albans dealer is the evening merchandising meetings sponsored by the gas company and at which there is always an instructor. Mr. Maher, his superintendent, bookeeper, two floor men and five salesmen are regular students in these classes. Occasionally special representatives of the gas company visit the dealer and work in the field with the salesmen.

This brand of sterling co-operation proves effective and has so influenced the plumbing and heating contractor that the only evidences of plumbing goods found in his store are a few chromium plated sink faucets and a Pyrolin toilet seat, shown in one of the windows along with water heaters and gas refrigerators. The appliances referred to are changed frequently as new and improved models arrive. Any new size, finish or make of range finds its way into a show window at once.

Explaining the change in the Phil Maher business, Superintendent Hazelbauer said recently:

"Although we continue to do considerable plumbing and heating work, particularly remodeling, we find there is considerable profit in gas appliance sales. We find the Brooklyn Union policy fair and helpful. When we sell any sort of gas appliance the customer is given the opportunity to pay in installments, the monthly amount being placed on the customer's gas bill. True, he pays for his purchase here, but we merely collect for the gas company.

"As soon as the appliance has been installed by us we receive our profit and most of our trouble has been transferred to the shoulders of the gas company. Yet, as our customers are home owners almost entirely and have been known locally for many years credit ceases to be a problem. We are doing what amounts to a cash business.

"In contrast to much of the business handled at present by plumbing and heating contractors, gas appliance business selling is more pleasant, more profitable and easier. We have enlarged our display room recently and expect soon to enlarge it again.

"Gas range business is not exactly new to us, for we have been selling ranges for many years. But never until the present did we have the high quality merchandise to show that we have today. Why, the gas range of modern design and finish looks almost like a radio or something that could well take its place in a home living room. One of our autumn brown cabinet ranges might be mistaken for a phonograph.

Tempting the Housewife

"It's hard for the uptodate housewife, particularly if she has visited new homes, to resist the improved appliance. And when she understands that she can pay for it on her gas bill she usually allows us to install one without delay.

"We find, however, that we have to do much more evening selling than formerly, for the womenfolk do not place orders at present without taking the matter up with their husbands. By making appointments, our

GLOVER-WEST VERTICAL RETORTS

Make Your Own Comparisons

GREAT responsibility hinges upon your choice of the right plant.

The efficiency of Glover-West Vertical Retorts in the low cost production of gas is shown by the records of the 330 installations which are in operation.

We invite you to study the financial returns of Glover-West plants.

West Gas Improvement Company

Builders of Coal Gas Plants

441 Lexington Avenue New York, N. Y.

Show the Housewife the Economy of Gas

(Continued from page 49)

ironed out. This personal, woman to woman talk gives them confidence in me, and they therefore believe me when I advocate a gas range in the interest of efficiency and economy.

"But it is not only at the home office that I preach the gospel of effective kitchen equipment. At our Better Homes Show last year this company had a very attractive booth. In addition to a good display of gas ranges, hot water heaters, and gas heaters, the booth was fitted up as a small lecture room, with a number of tables and chairs. Each day I gave a ten minutes talk on the effectiveness of the new gas range with the heat control oven. Some simple dish was prepared, and I showed them how easy it was to serve it without 'cooking the cook.' All during the week we linked up closely with the Better Homes Show, running a large ad on the same page as the daily comment on the Show appeared, stressing the fact that all the *better* homes had a modern gas range."

On one occasion, in marketing a new model range, the advertising manager stated that considerable newspaper copy was employed, and that they offered the range for $5 down, and a liberal price for the old range. Several windows were also devoted to featuring it and one that attracted special attention showed life size cut-outs of father and daughter. The father was sampling and praising a delicious cake and the daughter advised "Even you, dad, could make a cake as good as this in the blank range." Flanking the couple were two ranges in mottled green. Another window showed gas ranges in modernistic pattern—blue, black and green mottled with ivory—and the card "the world's most beautiful range."

But while the advertising department is given credit for effective display, it was concluded: "After all, the best way to advance sales is to be interested in the other woman and her household problems. If you can help her here she will be glad to listen when you talk to her about the line in which you are interested."

High Pressure Gas Distribution

(Continued from page 27)

and all threaded connections on the vent line should be made up and tested identically to gas carrying lines. Any practice which allows of only hand tight joints on a vent line with the idea that it is open to the atmosphere and will carry only a slight pressure, is courting trouble, not only from leakage, but it may be easily taken apart by children.

Any practice followed in low pressure districts may be duplicated from the outlet of the governor. It is sometimes desirable to have the line from governor to meter of a larger diameter than the outlet connection, for which purpose reducing fittings rather than bushings should be used and located near the governor as soon as practical, to provide the greater carrying capacity of increased sized pipe. Since a five-light meter bar usually has a ¾" inlet connection, there would be no advantage in carrying anything but a ¾" line from governor to bar. Where 1" connections to the meter bar are standard practice, a 1" outlet on the governor should be specified when ordering. Manufacturers can usually supply more than one diameter of outlet on any size governor to meet standard meter connection practices.

When all connections have been made, the shipping pin or block must be removed before testing, and it is good practice to remove the door plate to assure that a valve has been installed and is in its proper place. The mercury cup should then be filled, but before placing in position, blowing into the mercury chamber will be a check against pluggage of the vent passages resulting from poor casting or foreign material. Some utilities follow the practice of connecting the vent after the governor has been tested, to eliminate additional work should it be necessary to tighten the inlet threads or remove the governor. In this case the mercury is usually poured into the vent and flows into the cup, except where mercury savers are used. Installers will often develop the practice of testing the inlet connections before attaching the meter or vent lines, as a large number of leaks have been found on the nipple ahead of the governor. Inspectors and superintendents should often inquire regarding the repetition of leaks on any particular fitting, as considerably time can be saved by furnishing a better grade of fitting, especially with threads of the best quality.

When a faced disc is used, it is necessary before turning on the gas to raise the diaphragm sufficiently to close the valve several times to form a seat in the disc. On other types of discs, this practice may slightly assist the valve to form its seat, with a resulting lower initial lock-up pressure, but there is the likelihood of too great a force denting the disc unnecessarily or causing a crack in the disc surface. While it is possible to turn on the high pressure fast without causing either a momentary or complete governor blow, it is good practice to instruct employees having occasion to turn on governors to do so slowly, allowing a lock-up before fully opening the shut-off. Turning on suddenly may result in the orifice cutting too deeply into the disc or foreign material being carried onto the disc by the sudden rush of gas.

When desired, manufacturers will furnish a governor that can be sealed, so that tampering will be detectable. A wire with a lead seal is the most common method employed, the wire being carried through a hole in the removable top or top casting, through the flanges and through the lugs or bolts fastening the door plate. Rather than sealing a governor, there appear to be more reasons for locking the master control or meter cock in either the opened or closed position. If the cock is locked at all times, some consumers hesitate in breaking the seal in order to turn off a blowing governor previous to repair by the utility, which is necessary in rural sections where service men are not always immediately available.

(Continued in May issue)

SUPERIOR

Gas Meters
Provers
Service Cleaners
Diaphragms
Repairs

SUPERIOR METER CO.
167-41st Street
Brooklyn, N. Y.

BAROMETERS

PHILADELPHIA, THE WORKSHOP OF THE WORLD
has 14,000 Manufacturing Establishments of which many have World-Wide Reputations.

"PRINCO" STANDARD FORTIN MERCURIAL BAROMETERS

are in World-Wide use because they, too, have a "World-Wide Reputation"

THEY ARE GOOD BAROMETERS
THEY ARE REASONABLE IN PRICE

For more than a decade they have been made in such manner that they can be shipped safely and successfully wherever there is a common carrier. This has been recognized as an achievement in Barometry.

PRECISION THERMOMETER & INSTRUMENT COMPANY

1439 BRANDYWINE STREET - - - - - PHILADELPHIA, PA.

EQUIPMENT NEWS

New Air Cooled Gas Refrigeration

Electrolux Refrigerator Sales, Inc., 51 East 42nd St., New York, N. Y., subsidiary of Servel, Inc., announce a new air cooled gas refrigerator.

Air cooling is the first major development since the gas refrigerator was announced seven years ago. In most respects the unit is quite similar to the water-cooled Electrolux. The main refrigerating cycle is much the same. A small gas flame applied to the generator containing a 30 per cent solution of ammonia and distilled water vaporizes the ammonia and starts it on its cooling process.

Flowing on to the condenser, the ammonia gas is liquified by the cooling action of the room atmosphere over the fin-type coil. The room temperature in no wise affects the refrigerating efficiency, as the ammonia condenser in the new unit is of two-channel construction; when the load is light the ammonia passes through only a part of the coil, but when the room temperature is higher and the load heavier the ammonia automatically flows through the entire coil, subjecting it to a greater cooling surface.

Operating Parts of Electrolux

From the ammonia condenser the liquid ammonia passes into the lower section of the evaporator, which is of new and radical construction. It is of the two-temperature type, with a low temperature freezing coil directly in contact with the ice trays and an upper or secondary coil which is used for cooling the box as a whole when the necessity demands. Hydrogen gas within the refrigerating cycle, flowing in counter-direction from the ammonia, produces a rapid evaporation of the ammonia, thereby withdrawing heat from the ice trays and the box and thus causing refrigeration to take place.

The entire refrigerating unit will be without moving parts and completely silent. The whole refrigerating process is accomplished according to physic-chemical laws and gravity, by inter-action and reaction of hermetically sealed air, ammonia, water, hydrogen and methyl chloride, supplemented by a little gas flame which acts as the sole motivating agent. The entire unit is hermetically sealed.

In addition to air cooling, the gas refrigerator will have two-temperature control, with a five-variant temperature regulator. This will provide for much quicker ice cube freezing, quicker response to heavier refrigeration demands due to outer temperature changes, and non-stop defrosting, a feature said to be unique with the gas refrigerator.

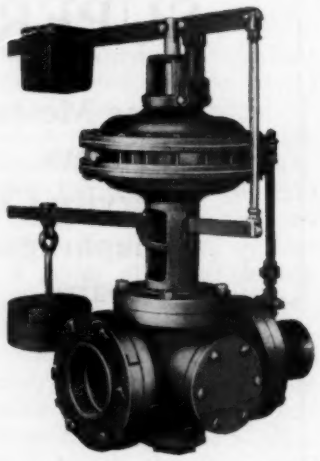
It will be manufactured in five domestic sizes, and ultimately in all sizes. Distribution will be through utility companies, and list prices are substantially below last year, the announcement stated.

Elimination of water in the cooling process of the gas refrigerator will mean a substantial saving in operating, installation and servicing costs, and will place the gas industry in a very much stronger competitive position with respect to electric refrigeration.

New Regulator for Medium Gas Pressure

The Choplin-Fulton Co., Pittsburgh, Pa., have added a new gas regulator to their line. The new governor is specially designed for the sensitive regulation of medium gas pressures without the use of pilot or auxiliary controls.

The new device is adapted for use where gas at high inlet pressure—50 to 100 pounds or over needs to be reduced and kept constant at say 5 to 10 pounds, in the distribution system. Patterned after the Duplex Low Pressure Regulator made by the same company, this new device employs two diaphragms moving in opposite directions but exerting their power in the same direction, one being immediately connected to the valve stem, the other connected indirectly by a toggled lever which multiplies its force and reduces frictional resistance to a minimum. Such a method of operation results in great sensitiveness and power.



The Fulton Duplex Medium Pressure Regulator, as it is called, may be equipped with "V-port" valves for operation under light loads. The "V-port" valve is effective for half the lift of the valves so that there is no restriction to the passage of the gas at peak loads.

New Bell Type Retort Furnace

The American Gas Furnace Co., Elizabeth, N. J., announce a new line of Bell Type Retort Furnaces.

They state that "Manufacturers everywhere have learned the necessity of operating economically whether on a comparatively small production basis or their maximum capacity and in consequence their ideas regarding equipment are undergoing fundamental changes.

"Equipment manufacturers have come to appreciate the wisdom of this change in policy and to design their equipment accordingly. An example of this is found in the New Universal Heat Treating Tool, as the Bell Type Retort Furnace."

It is adapted for carburizing, nitriding, or either a carburizing hydrocarbon gas, ammonia for nitriding, or a neutral or inert gas for bright annealing, etc. Equipment, according to the manufacturer, can also be used for hardening, normalizing, annealing and tempering.

Because of the wide range of heat treatment possible, this equipment is ideal for the jobbing shop where a great variety of work is handled from day to day. In fact, it is here that its outstanding flexibility is most pronounced. For the larger shop it is equally desirable because a battery of them may be installed and carburizing or other heat treating operations may be carried on simultaneously. Carburizing may be carried to a depth of 1/16" in one furnace and 1/64" only in the adjacent furnace. Other heat treating operations

Like Bees Making Honey

The millions of finely divided particles of Fe_2O_3 $(_3H_2O)$ in our new **G. P. M. IRON HYDROXIDE** are as *ACTIVE* as bees making honey.

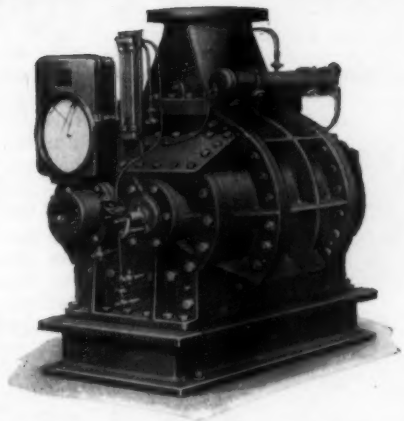
This oxide should not be confused with any other. It is a result of research—is made different—gives lasting quality combined with high activity and maximum percentage removal.

Gas Purifying Materials Co. Inc.

FOOT OF HALSEY STREET — OXIDE — LONG ISLAND CITY NEW YORK

BRANCH YARD, PROVIDENCE R.I.

ECONOMY



Medium-size, high-pressure meter, fitted with a P. V. T. T. Recorder.

An oil-gas plant in the Southwest had for years estimated their "unaccounted-for" at 15%, but the recent installation of a Connersville Meter proved it was actually above 35%.

They have since reduced their actual "unaccounted-for" to 16%.

In addition to this very considerable saving, the operators, knowing their make, have succeeded in reducing their oil consumption about 10%, and are making gas of uniform 550 B.t.u.

This experience is merely typical of many advantages to be gained from the installation of Connersville Meters.

Bulletin 40-B10 gives full descriptive details. It will be gladly sent upon request.

ROOTS
CONNERSVILLE
WILBRAHAM

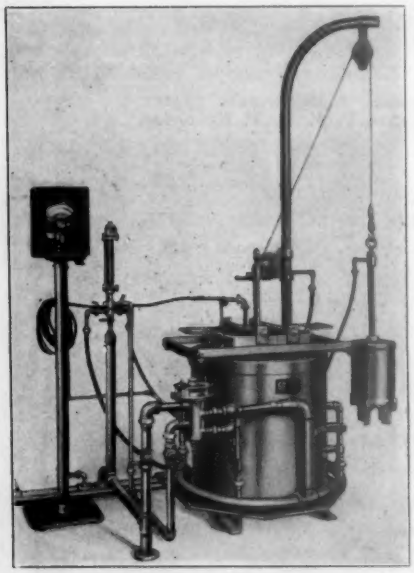
12th & Columbia, Connersville, Ind.

New York **Chicago** **St. Louis**
Pittsburgh **Dallas**
Pottstown, Pa. **San Francisco**

RCW

may be performed in still other furnaces. One or more furnaces may be shut down if not required without reducing the efficiency of operation of the remainder.

In the small commercial heat treating shop and tool room shop it is important to be able to complete small orders quickly. For this purpose the bell type furnace is ideal. Small sizes are available which may be quickly heated to temperature and various heat treatments may then be performed successively with minimum delay. It is necessary only to have two or three spare bells with bases available to permit carburizing, then hardening followed by tempering. In annealing, to obtain a full anneal, work may be allowed to remain over night in the furnace after it has been shut down. This



also applies to carburizing, should it be desired to obtain maximum diffusion and graduation of case to core. In this case the carburizing gas should be allowed to continue to pass through the retort during the slow cooling period, burning in the furnace and thus retarding the rate of cooling.

Where comparatively slow cooling is satisfactory, the bell with its base and work may be removed from the furnace and air cooled or placed in a pit or insulated shop can, for relatively slow cooling.

Quenching direct from furnace temperature can be accomplished either by removing the bell, allowing the work on the base to remain in the furnace for removal of the individual pieces and quenching, or, as for example in the case of ring gears or other comparatively large gears, a special yoke may be used to elevate the base and work slowly so that the individual gears may be withdrawn and quenched in a jig, fixture or quenching machine, as desired.

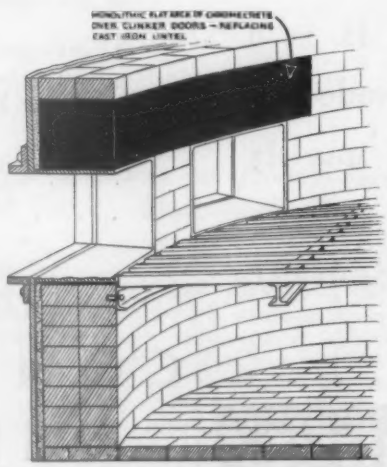
These various advantages are obtainable in furnaces of the correct size for the work to be done. The bells are not necessarily cylindrical in shape but may be rectangular or may take some other shape if better adapted to the particular work. In addition, uniform results are obtained because the retort is entirely enclosed in the furnace, thus making it possible to maintain it very uniformly at the desired heat.

In the case of carburizing, the spent carburizing gases escape from the bottom of the bell and are consumed in the furnace, thus increasing the efficiency. Furthermore, radiation losses are low because the bell is entirely enclosed by the furnace, which results in greatest fuel economy.

Extra bells are supplied according to the nature of the requirement so that the furnace can be maintained in production all the time. Furnace is provided with Automatic Temperature Control, and a special feature is the Flow Meter for checking the flow of gas through the retort at all times. Two or more Flow Meters can be supplied if desired where two or more gases are to be mixed for passing through the retort.

A New Natural Base Castable Refractory

Quigley Company, Inc., 56 W. 45th St., New York, announce a new refractory called "Chromecrete." It is a chrome-base castable refractory which has given remarkable results when used for building monolithic flat arches or lintels over clinker doors of water gas generators.



Advantages claimed for Chromecrete for Lintels are that no cast iron lintels are used, brick above the lintel do not move, loosen, fall out, or require replacement, other than at extremely long intervals, eliminates shutdowns due to warping and blocking of doors, and saves cost of replacing cast iron lintels and brickwork.

Chromecrete is easy to handle and install, sets quickly at room temperatures, and forms a monolithic structure of great strength and durability. It is practically free from shrinkage or expansion, has good spalling resistance and withstands temperatures up to 2800°F. In addition, it is resistant to slagging and clinker adhesion. It comes in dry form,

and is mixed with water on the job, to bring it to a mortar consistency. Simple wooden or sheet metal forms are set into place, and filled with Chromecrete. The forms are removed four to six hours after it has been poured. As it is hydraulic setting, the formed material should be dampened with water several times before being put into service, using a hose with a mist spray. Three or four wetting-downs over a period of twelve hours are ample. Let stand for another twelve hours or so to gain full set and dry out. It can then be subjected to heat, starting the fire slowly, and building up to full.

For surface patching of Chromecrete lintels, remove loose particles and dust with brush or air line. Wet entire area to be repaired and apply a bonding coat of neat (undiluted) Hytempite or Quigley retort cement. Then apply Chromecrete mortar of troweling consistency, building up to level desired. Trowel smooth, let set for 24 hours, and return generator to service. Dampen patch three or four times after it has acquired its initial set.

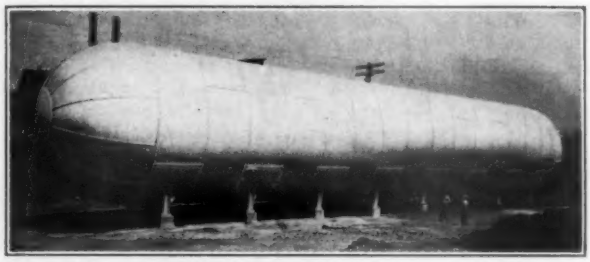
Up to the present time, the use of Chromecrete has been limited largely to the "lintel" application herein described. Its advantages for this use have been thoroughly established in many gas plants. Some gas plants have extended its use from construction of the lintel proper, to include also sections between and alongside of the doors. Descriptive booklet will be mailed on request.

Notice

The series, "Elements of Gas Technology," is being prepared by J. F. Hanst, an engineer, whose experience extends over twenty-five years and has been concerned with coal, manufactured gas and natural gas technology

STACEY "BULLETS"

for high pressure gas storage



The Stacey "Bullet" is widely used for reserve storage at the end of branch lines; for storing gas for use during peak loads; as a reserve against line breaks; for serving outlying territories, and on local distribution systems.

Stacey "Bullets" are constructed vertically as well as horizontally where desired. In this manner they offer the maximum of storage for the minimum ground space.

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NEWS of the GAS INDUSTRY

Philadelphia Gas Works Has Big Reconstruction Plan

Philadelphia Gas Works, Philadelphia, Pa., subsidiary of United Gas Improvement Co., has announced a comprehensive plan of reconstruction to increase the operating efficiency of its system. F. M. Milward Oliver, vice-president, said that the project will require five years to complete. The new plan has been made necessary by changed living conditions, shifting population centers and other phases of growth in the area served by the gas works.

Among the first major steps of the general plan to be undertaken are: Construction beneath the Schuylkill River just above the Passyunk Avenue bridge of a tunnel of sufficient size to hold two 30-inch transmission mains, through which gas will be piped to serve the West Philadelphia area; the installation of 2.5 miles of new 30-inch main; the installation of 1.85 miles of 20-inch transmission main and of 2.8 miles of 16-inch main to increase the supply of gas to the southeastern portion of the city. There is also involved the installation of additional pumping capacity.

Among the other work to be undertaken, new gas pumping and compressing equipment will be installed at various stations. Total cost of the project will approximate half a million dollars.

Air Conditioning Course at Rutgers

Representatives from more than one-third of the states of the Union, and the Dominion of Canada, have enrolled in the home correspondence study course in Air Conditioning, announced about two months ago by the University Extension Division of Rutgers University (the State University of New Jersey) in New Brunswick, N. J. The student body in the course now includes utility presidents, college professors, engineers, technical consultants, commercial leaders, plant superintendents, and technical men in many lines, all from states extending across the entire continent.

The course is arranged to give the student a thorough knowledge of the basic material of Air Conditioning, preparatory for the more technical and advanced subjects treated in detail in the later sections. The material provides for the study of basic computations, the engineering estimate, all types of equipment and apparatus, distribution systems, conditioning equipment, and control systems. Because of the high quality in the type of students, examination reveals that exceptionally high-grade work is being done by all engaged in this training program.

Convention Calendar

April

10-12 Mid-West Gas Association, annual convention.
Des Moines, Iowa.

21 Maryland Utilities Association.
Lord Baltimore Hotel, Baltimore, Md.

27-28 Missouri Association of Public Utilities.
Jefferson Hotel, St. Louis, Mo.

May

2-4 A. G. A. Southern Regional Sales Conference.
Washington, D. C.

2-4 Southern Gas Association, annual convention.
Shoreham Hotel, Washington, D. C.

2-5 Chamber of Commerce of United States.
Washington, D. C.

9-11 Pennsylvania Gas Association.
Wernersville, Pa.

17-19 American Petroleum Institute, Mid-Year Meeting.
Tulsa, Okla.

22-23 American Gas Association Joint Committee Conference of Production & Chemical Committees.
Hotel New Yorker, New York, N. Y.

June

1-2 American Gas Association, Executive Conference.
Chicago, Ill.

12-15 National Association of Purchasing Agents.
Chicago, Ill.

26-28 Advertising Federation of America & Public Utilities Advertising Association.
Grand Rapids, Mich.

26-30 American Society for Testing Materials.
Chicago, Ill.

26-30 American Society of Mechanical Engineers.
Chicago, Ill.

26-30 American Institute of Electrical Engineers.
Chicago, Ill.

September

18-19 Canadian Gas Association, annual convention. Ottawa Can.

Week of September 25, Annual Convention of American Gas Association, Chicago, Ill.

Gas Heat Makes Possible Efficient Metal Spray

Economy in the field of metal spraying has been effected by the introduction of gas for melting and the number of commercial applications has been greatly multiplied thereby. A new process, recently developed, applies various metal coatings to other metallic or non-metallic surfaces to fill cracks or fractures or worn surfaces, and to act as a preservative against corrosion.

The metal which is to be sprayed on the surface to be treated is first fed into a spray-gun in the form of wire, reports the New Jersey Public Utility Information Committee. This wire is then drawn through an oxy-gas flame, the temperature of which varies with the metal being used. The molten metal is then atomized evenly over the surface or joint of pneumatic pressure. The process combats erosion as well as corrosion and does not affect the surfaces being treated since those surfaces do not require pre-heating.

Company Files Articles of Incorporation

Articles of incorporation have been filed with the secretary of state in Indianapolis by the Triangle Oil and Gas Company, Inc., of Washington, Ind. The corporation has an initial capital stock of 150 shares having a declared par value of $40 each and is formed to drill for gas and oil. The incorporators are Cassius M. Amsler, Clarence W. Gilmore and Julius Koeling.

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—no other tool, no skilled labor, and yet four miles of 10-inch cast iron pipe with mechanical joints were installed in two weeks' time. The line carries 100 lbs. natural gas pressure. It tested gas-tight. The various mechanical joints made by members of the Association are fundamentally gas-tight. Address inquiries to The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 309 Peoples Gas Building, Chicago, Ill.

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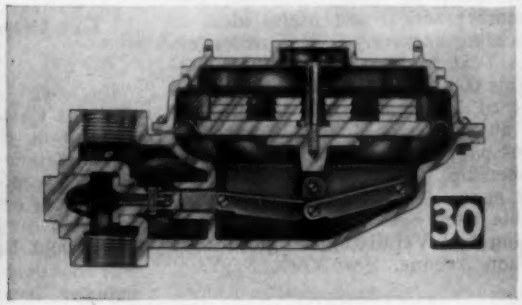
REYNOLDS MODEL 30 REGULATOR

More than forty years ago Reynolds Gas Regulator Co. built and patented the little giant, toggle type regulator the forerunner of the present model 30. The basic operating principles of the original toggle type and that of the present are similar. However, the method of manufacture has kept step with the times—modern engineering, improved design and better materials have increased the efficiency of the present unit. The accuracy, the quick response of model 30 to varying load demands; the uniform control of outlet flow when line pressures vary; the interchangeability of parts and lowered maintenance costs are the results. In a field as technical as that of the Gas Industry, "tried" and "proved" performance are two *musts* vitally important to the success of an installation. Reynolds model 30 toggle regulator is a "tried" and "proved" product. The record of performance in actual operation is the evidence that marks this gas control unit as the finest of its type ever built. Model 30 is available in either spring or dead weight adjustment for horizontal or vertical connections.

- ***Write direct to branch offices or representatives***



- **REYNOLDS BRANCH OFFICES:** 422 Dwight Building, Kansas City, Mo.; 2nd Unit, Santa Fe Building, Dallas, Tex.
- **REPRESENTATIVES:** Eastern Appliance Co., Boston, Mass. F. E. Newberry, Avon, N. J.

REYNOLDS GAS REGULATOR COMPANY
Anderson, Indiana, U. S. A.

GAS CONTROL SINCE 1892

Consolidated Gas Reports Splendid Cooperation in the Sale of Gas Equipment

More plumbing and heating concerns and retail dealers co-operated with the Consolidated Gas Company and its affiliated gas companies in the sale of modern gas equipment in 1932 than in any year previous.

A total of 120 plumbers and dealers in Manhattan, Bronx, and the first and fourth wards in Queens took an active part in this cooperative sales program, Mr. Fogg stated. During the year, thirty concerns were added to the list, representing the largest annual increase in the number of gas appliance dealers on record in this territory.

"Many dealers more than doubled their net profits from gas appliance sales as a result of their active participation in the cooperative plan," Mr. Fogg said. "The ultimate aim of this cooperation is the exclusive sale and handling by all appliance dealers within our territory of gas-burning equipment which bears the approval seal of the Testing Laboratory of the American Gas Association."

Merchandising counsel and display and advertising material is supplied by the Company to the cooperating dealers. All types of approved gas appliances are sold by the dealers.

The A.S.H.V.E. Guide 1933

The American Society of Heating and Ventilating Engineers Guide 1933 is now available. This 11th Annual Edition of the standard reference volume on heating, ventilating and air conditioning appears in an entirely new "dress" and the contents have been extensively enlarged and revised to include the latest results of research and modern engineering practice. Compiled by the foremost engineers in the profession, The Guide 1933 embodies in its 45 chapters not only data developed at the A.S.H.V.E. Research Laboratory and cooperating institutions, but also the most practical and useful ideas of outstanding engineers in the profession.

The Text Section of The Guide 1933 contains 608 pages, supplemented by 180 pages of Manufacturers Catalog Data with an index to Modern Equipment, also 64 pages of the A.S.H.V.E. Roll of Membership.

852 pages. Single copies $5.00. Obtainable from the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York, N. Y.

College Largest Consumer of Natural Gas

Between 50,000,000 and 60,000,000 cu.ft. of gas are expected to be used annually in the heating plant of Central Teachers College, Mount Pleasant, Mich., which was converted to gas recently. Engineers estimate a cut of 20 per cent in heating costs.

Officials of the Gas Corporation of Michigan say the college is the largest single consumer of Michigan natural gas.

The heating plant load has increased the market for natural gas about 40 per cent and will result in the company adding two or more wells to its Vernon fields. It now draws from three Vernon wells.

Engineering Week of Interest to Gas Industry

Plans for the huge conference of engineers at Chicago, during Engineering Week, June 25-30, sponsored by the Century of Progress Exposition, are making excellent progress. Engineers of the gas industry will be particularly interested in the sessions of the American Society of Mechanical Engineers, the American Petroleum Institute, the American Society of Heating and Ventilating Engineers and the American Institute of Electrical Engineers. Some twenty of the National engineering societies will also participate with sectional and national meetings.

In addition to the many interesting educational exhibits at the Century of Progress Exposition, engineers of the gas industry will also see much of value at the Sixth Midwestern Engineering and Power Exposition, to be held at the Coliseum during that week. At this exposition some 300 manufacturers will show the latest developments in steam generating equipment for power and process purposes. In addition there will be a wide range of equipment such as gas burners, ventilating and air conditioning equipment, pumps, electrical apparatus, etc.

The combined membership of the engineering groups participating in Engineering Week is 91,600. Preliminary estimates of attendance indicate the largest gathering of engineers in history.

Gas Displays at the Chicago Exposition

Engaging 4,000 square feet of exhibit space at Chicago's Century of Progress Exposition, the A.G.A. now has under consideration details for its gas industry display, according to C. W. Berghorn, director of exhibits for the Association. Location of the exhibit will be in the Home and Industrial Arts Building; it will convey a general picture of the gas industry, leaving equipment displays to the individual manufacturers who may contract for separate exhibits. Several of these will also be housed in the Home and Industrial Arts Building, and eight model homes in which gas will be used will be built around the same structure. A number of stove manufacturers will exhibit in connection with a porcelain-enamel display. "Gas, the Ideal Fuel for Home and Factory" will be the A.G.A. exhibit theme.

Atlanta Ice Plant to Use Natural Gas

Approximately 14,000 MFC of natural gas a year will be used by Plant No. 2 of the Consumers' Ice Company, at the corner of Jackson and Decatur Streets following installations made by the Atlanta Gas Light Company. The equipment consists of one three-cylinder vertical gas engine, of 160 horse-power capacity, with an integral single-cylinder ammonia compressor, and one single-cylinder horizontal gas engine of 60 horse-power V-belt connected to an AC generator to furnish auxiliary power.

Mohawk Asphalt Heater Company Moves Into New Quarters

The Mohawk Asphalt Heater Company, for many years located at Schenectady, New York, recently announced the removal of its factory and general offices to a new, modern building at Frankfort, New York.

The new plant is up-to-date in every respect, and will house factory, warehouse, showroom and offices under one roof. It is of steel and concrete construction, with wire glass, steel-sash windows on all sides, giving plenty of light and air. Straight line production methods will be used throughout, in the new factory, giving a steady progression of processes from raw material to finished product, and it is hoped by the management that with the more modern setup, Mohawk will be in better position than ever to serve its thousands of customers throughout the nation, and to maintain its position as a leader in the industry.

Mohawk pioneered in developing an asphalt heater specially designed for the use of oil as a fuel, and will continue to manufacture the "Hotstuf" Asphalt Heater, famous for its "Elevated Melting Chamber" which melts asphalt 30 to 50 per cent more efficiently; "Hotstuf" Tool, Asphalt and Surface Heaters; Mohawk Improved Torch Type Oil Burners; Concrete Heaters, Salamanders and Water Heaters; Mohawk Hi-Speed Tool and Supply Trailers; Mohawk Pole and Pipe Trailers; and other allied products for use by State, County and Municipal Highway Departments, Highway Contractors, Roofers, Public Utility Companies, etc. With the more modern manufacturing facilities, and plenty of room for expansion, it is planned to add new lines as conditions improve and their need becomes apparent.

Correction

On page 26, March issue, the item, "Oregon Rejects Bill," is erroneously credited to Paul Ryan.

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Effect of Attitude on Limits of Safe Operation of Gas Appliances

(Continued from page 23)

VI—Effect of Altitude on the Injection of Primary Air

The effect of changing altitude on the injection of primary air is inappreciable when the orifice size, the drop in pressure through the orifice and the air shutter are left unchanged. A somewhat lower gas rate in B.t.u. per hour results at the higher altitude.

When the orifice is enlarged so that the gas passes at the same rate in B.t.u. per hour at the higher altitude, the pressure drop and air shutter remaining unchanged, a slightly lower percentage of primary air is injected, as might be expected when the orifice is enlarged. The difference is of no great significance with most appliances, since it cannot be detected from the appearance of the flames, and the original amount of air injected can usually be restored by opening the air shutter.

In the case of water heater B, it can be seen from Figure 2 that the air in the primary mixture which will permit gas to be burned safely at the maximum rate varies but little with altitude, from 61 per cent of the total required at 200 feet to 57 per cent at 10,900 feet. Most of the other appliances tested showed even less variation and none of the five for which the necessary data were obtained showed a greater change. The range of uncertainty in the usual adjustment (by appearance) of appliances in use is considerably greater than this, hence, no difference in the composition of the primary mixture supplied to appliances at different altitudes need be provided for by the designer or in the instructions to adjusters.

VII—Effect of Altitude on the Efficiency of a Top Burner of a Range

The efficiency of a top burner of a range was determined in the manner described in Research Paper No. 446[4], with the burner operating at its "normal" rating and with the primary air set at about 55 per cent of the total air required. The average of the results obtained at sea level was 31.0 per cent, as compared with 33.2 per cent obtained at an altitude of 10,400 feet. Variations in excess of 2 or 3 per cent are not uncommon under normal operating conditions and, therefore, the apparent effect of changing the altitude obtained in this test cannot be assumed to be of much significance.

[4] *See footnote* 1.

VIII—The Effect of Altitude on the Operation of Pilots

A blue-flame pilot will be affected by altitude in exactly the same manner as the flame on any of the ports of the burners of an appliance. For example, in a blue-flame pilot of fixed mechanical construction, the ratio of primary air to gas will be practically unaffected by altitude and probably will not change when different orifice pressures are used.

To operate safely, a pilot must not only be safe from blowing off at the highest pressure likely to be encountered, but it must also ignite the gas with certainty at the lowest pressure. Hence, to be safe at a high altitude, the pilot light should ignite the gas at sea level at the lowest rate in B.t.u. per hour likely to be delivered at the higher altitude.

A yellow flame pilot burns gas with no admixture of primary air and tests were necessary to determine the extent to which altitude would affect flames of several given heights burning on ports of different sizes. For these tests both the mixed gas of the city supply and propane were used.

The gas rate and corresponding height of flame were determined for two sizes of port (No. 66 and No. 48, drill manufacturers' standard) at sea level and at 9900 feet, in one case with a flame about 2 in. high, and in another case at the gas rate at which the flame blew away from the port. When the height of each flame was plotted against the gas rate, all the points fell very close to a single straight line for flames up to 6 in. high. This indicates that for all practical purposes the height of an unaerated gas flame from a small opening such as is used for a pilot light is determintd by the gas rate in B.t.u. per hour, regardless of altitude, size of port, or the kind of gas used.

The flame which lifted most easily was that of propane, at the highest altitude, on the small port. It had a height of 6 in., which is at least three times that needed for most pilots. This indicates that, with a yellow flame pilot, lifting from the port is not likely to be a source of difficulty at high altitudes any more than at sea level.

IX—Effects of Altitude Compared on two Different Gases

In the case of the manually operated calorimeter, the primary air was set just high enough to eliminate yellow tips from the flame, and the maximum safe gas rate in B.t.u. per hour was determined with the flue damper both in the open and in the closed position. This was done at sea level and at an altitude of 10,000 feet, using mixed gas and propane.

The results indicate that the maximum safe gas rate, at a given altitude, with the damper open was almost exactly the same with both gases.

With the damper closed, the maximum safe gas rate at both altitudes was about 100 B.t.u. per hour less with propane than with mixed gas. The reduction of the maximum safe B.t.u. rate at sea level required for each thousand feet of altitude is also about the same for the two gases.

It therefore seems probable that the effect of changes of altitude with other appliances will not be very different for gases of different compositions.

X—Summary and Conclusions

Nine gas appliances of distinctly different design were studied, and the effects of altitude on the limits of safe operation were found to be nearly the same for all of the appliances tested, with the exception of radiant heaters, which appeared to be more affected than other appliances. Excepting the radiant heaters, the maximum safe gas rate, in B.t.u. per hour, is reduced between three and

(Continued on page 64)

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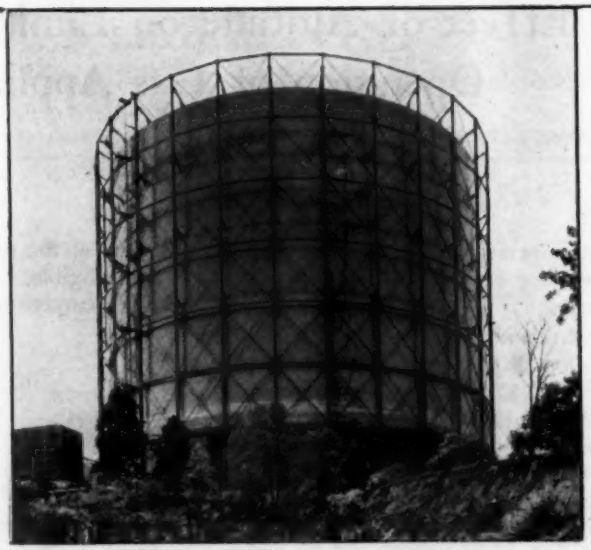
1600 ROOMS . 1600 BATHS



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The Reliable Shut-Off for Street Mains

Equipped with Improved Patented Locking Sleeve, which locks both handles to the pipe. Stopper cannot slip. Gas cannot pass.

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Effect of Altitude on Limits of Safe Operation of Gas Appliances

(Continued from page 62)

four per cent of the safe rate at sea level for each thousand feet of elevation.

It is a simple but only roughly approximate general rule that an appliance, adjusted to take the same ratio of primary air to gas at two altitudes, can, without other adjustment, burn completely the same number of cubic feet of gas per hour at both altitudes. It will also receive the same volume of primary and of secondary air, and will deliver the same volume of flue gases of the same composition at both altitudes. All of these volumes are as measured at the local barometric pressure at each altitude.

To construct an appliance for safe use at a high altitude, it must be designed as a whole to burn safely at sea level an appropriately greater quantity of gas. Some data are given from which preliminary estimates may be made of the necessary size of flue passages for certain types of appliances.

The effect of a change of altitude on the injection of primary air is not great enough to be detected from the appearance of the flames.

Unaerated or yellow flame pilots are unaffected by changes in altitude, unless they are "smothered" by products of combustion from the main burner. Blue flame pilots are affected in the same manner as are the ports of the main burner.

At the normal rate in B.t.u. per hour specified by the manufacturer, the percentage of primary air required to make the flames lift from the ports is reduced for each thousand feet of elevation by about 1.25 per cent of the "total air required for complete combustion." The rate at which a given mixture of gas and air can be delivered from a port without causing the flame to lift is reduced about 4.5 per cent per thousand feet of altitude if rates are expressed in B.t.u. per hour, or about 1.75 per cent if they are expressed in cubic feet per hour.

The effect of altitude on the efficiency of the top burner of a range was negligible.

The temperature of the flue gases has little relation to the altitude, but is almost entirely a function of the gas rate in B.t.u. per hour.

The effect of altitude in reducing the amount of gas that can be burned completely in a calorimeter was found to be the same with propane as with mixed city gas. It is concluded that the effects would have been the same had the comparison been made with other appliances or other gases.

Personals

Frank L. Dame, was recently elected president of the North American Company to fill the vacancy caused by the death of Edwin Gruhl.

Mr. Dame also remains chairman of the board, which office he assumed April 25, 1932, when Mr. Gruhl became president.

George D. Dodd, formerly superintendent of the Street Department of The Laclede Gas Light Company, has been appointed Superintendent of Distribution to succeed the late Eugene P. Lynch, who died February 8, following an operation for glandular trouble.

Henry Obermeyer, Assistant to Vice-President, has been placed in charge of the advertising of the gas and electric companies affiliated with the Consolidated Gas Company of New York.

Mr. Obermeyer has been with the Consolidated Gas Company for seven years, in charge of advertising for the group of gas companies. Prior to this he was with the American Gas Association.

A. E. Strong, who for the past two years has been in charge of plant operations of the Natural Gas Corp. of Washington and Natural Gas Corp. of Oregon with offices in Portland, Ore., has been transferred to Santa Cruz, Calif., as general superintendent of the Coast Counties Gas and Electric Co., a position he held two years ago. Prior to Mr. Strong's transfer to Portland he was with the Coast Counties for over 24 years.

Sidney Z. Mitchell, who began in the utility industry in the days of Thomas A. Edison, has resigned as chairman of the board of Electric Bond and Share Co., due to ill health. It was announced Mr. Mitchell will also resign all other business connections.

He will be succeeded as chief executive of Electric Bond and Share, which he helped to found in 1905, by C. E. Groesbeck, formerly president, who in turn will be succeeded by S. R. Inch, formerly executive vice-president.

S. Quay King, superintendent of the Greensboro Gas Co., in Jeannette, Irwin, West Newton, Charleroi, and Donora, with main offices in Jeannette, Pa., has gone to Steubenville, Ohio, to be superintendent of territory covering that city, Mingo Junction, Ohio; New Athens, Ohio; Weirton, W. Va.

Mr. King was succeeded in Jeannette by J. Hall Spear, former superintendent of the Fayette County Gas Co., in Connellsville, Pa.

James F. Fogarty, of New York, vice-president of The North American Company, was elected president of North American Light & Power Company at a meeting of the directors in Chicago. His election filled the vacancy caused by the death of Mr. Gruhl, president of The North American Company, who became president of North American Light & Power Company on December 21. Mr. Fogarty has been a director of the latter company since July, 1932.

P. L. Vandevoir, has been appointed new-business manager of the Indiana Gas Utilities Co., Terra Haute, Ind., to succeed J. J. Mandel, former business manager, who has been transferred to Sioux Falls, S. D.

S. E. Cowan has been appointed sales manager of Utah Gas and Coke Co., Salt Lake City. He succeeds L. D. Simmons.

Frederick A. Lydecker, general superintendent of gas distribution, Public Service Electric and Gas Company, was elected president of the New Jersey Gas Association at its annual convention in Camden, March 16. Other officers chosen by the State gas group on that occasion to serve during the 1933-34 association years are: **E. J. Menerey,** of Peoples Gas Company and **Herbert E. Cliff,** Public Service Electric and Gas Company, first and second vice-presidents, respectively, and **George B. Webber,** Public Service Electric and Gas Company, secretary-treasurer. Directors, chosen for a term of three years, are: **John A. Clark,** vice-president in charge of gas operation, and **H. P. J. Steinmetz,** general sales manager, Public Service Electric and Gas Company, and **Chester Grey,** of the Atlantic City Gas Company.

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Trend of the Natural Gas Industry

(Continued from page 18)

and this explains why so many pipe line companies are in the red.

New uses must be found for natural gas, and perhaps the solution of this problem lies in the chemical industry. Some work has already been done along these lines by the U. S. Bureau of Mines and in December, 1930, an information circular No. 6388 was issued giving a resumé of the investigation. Included in the circular is a chart showing the possible utilization of natural gas for the manufacture of chemical products.

There is at least one plant in the United States which has been utilizing natural gas for chemical purposes for several years. This is the plant of the DuPont Chemical Company near Charleston, West Virginia. There natural gas is treated for the manufacture of ethylene glycol, ammonia, and various alcohols. The process involves pressures of 15,000 pounds per square inch, which is obtained by a series of special high-pressure compressors, and is probably the highest pressure used commercially anywhere in the United States. It is entirely probable that other plants for the transformation of natural gas into chemical products will be erected, when and if the market conditions for those products justify the heavy investments necessary. Development along these lines, therefore, will be slow.

Vast Industrial Uses

It is not generally realized that the use of natural gas for field purposes constitutes the largest single item in industrial consumption. With a falling off in field activities during 1931 and 1932, the natural result is a great decline in consumption. The next most important industrial use of natural gas is for the manufacture of carbon black, and here again a great decline is noted. These two items are the principal cause of the sharp drop in the curves shown on Chart I. and are indicative of general business conditions, since they reflect back through a great number of industries, oil and oil products, steel, rubber, paints, automobiles, inks, machinery and many others.

The competition from cheap coal and oil is another factor influencing sales of natural gas, but the Bureau of Mines statistics show that the domestic consumption of natural gas in the important coal producing states increased 7 per cent between 1925 and 1930 while gaining 98 per cent in the same period in states which are not important coal producers. This indicates that coal is still a serious competitor of gas for house heating. The industrial use of natural gas in the coal producing states, exclusive of its consumption in the field, at refineries, public utility power plants and carbon black plants, shows an increase of 33 per cent between 1925 and 1930 while the use of bituminous coal for industrial purposes showed a decline of 10 per cent in the same period. In the states outside of the important coal areas, sales of natural gas to industrial consumers gained 88 per cent in the six years ending with December, 1930. This shows that such sales have followed the line of least resistance and that gas cannot yet compete with coal for industrial purposes in localities near the mines.

It is interesting to note that in the domestic field an entirely different picture is presented. The price of natural gas for home consumption has had a constant upward tendency for the past several years while other fuels have declined in price, and while gas as a fuel in the home has manifest advantages in cleanliness and convenience, if the price continues to go upward, it will surely tend to drive all but the wealthiest users back to coal, coke or fuel oil. With the enormous reserves in the field that are available and with constant improvement in house heating appliances, there should be no reason for the price of gas for purely domestic use being advanced for many years to come. On the contrary, the natural gas companies should make every effort to reduce it sufficiently to make the use of gas increasingly attractive to the house-holder, and this applies equally well to the companies distributing manufactured gas. This would go a long way toward building up a steady and profitable domestic load which would tend to counteract any violent fluctuations in the industrial load.

To sum up, the general trend of the natural gas industry is still upward, in spite of temporary setbacks, and with a resumption of general business, it should move forward to greater heights than have yet been attained.

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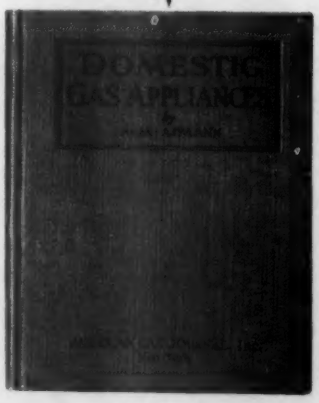

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